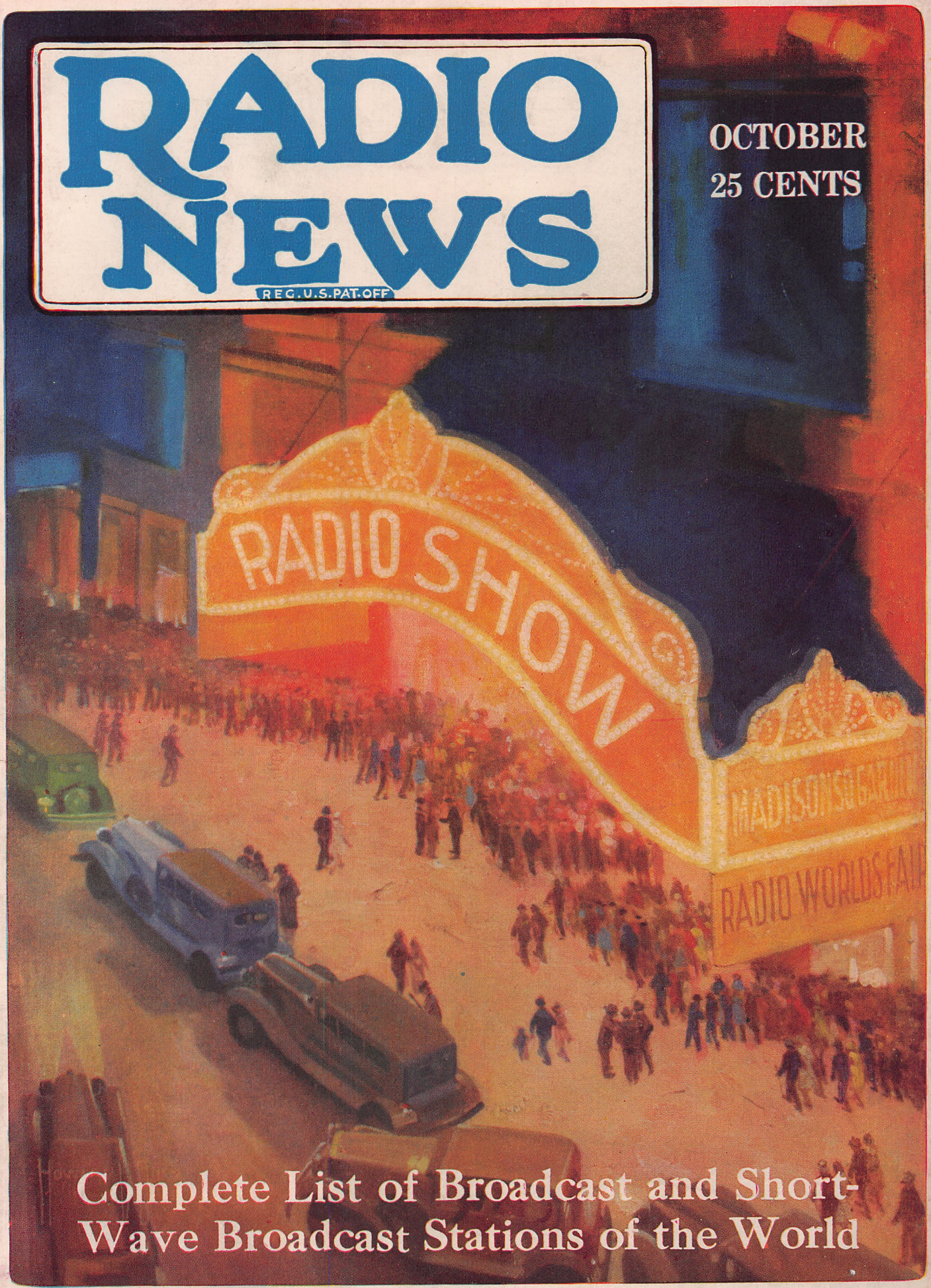
RADIO'S GREATEST MAGAZINE

# RADIO NEWS

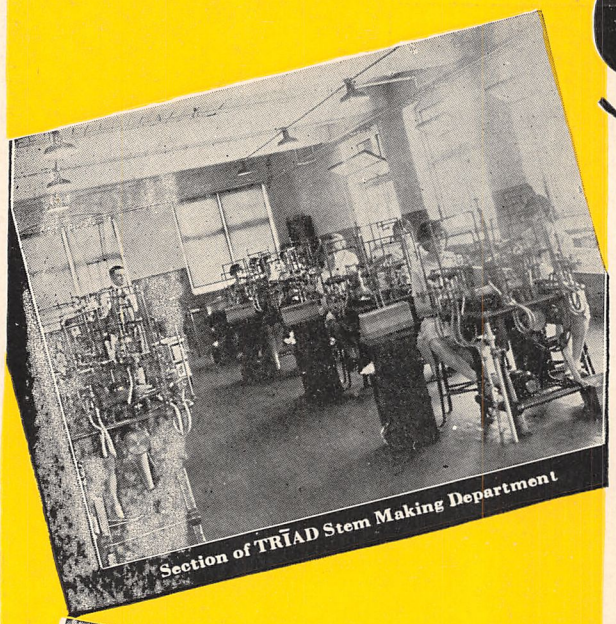
REG. U.S. PAT. OFF.

OCTOBER
25 CENTS

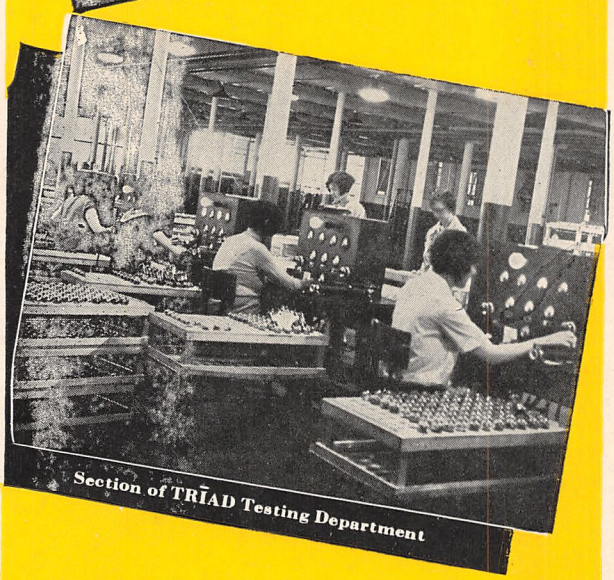



## Complete List of Broadcast and Short-Wave Broadcast Stations of the World

# 9 Final Tests ... to assure *perfection*



Section of TRĪAD Stem Making Department



Section of TRĪAD Testing Department

TRĪAD Packing Dept.

*Naturally* — every TRĪAD Tube is constantly, rigorously tested throughout the entire manufacturing process — a special test follows every individual operation. Yet TRĪAD does *more than that!* When completed, each TRĪAD Tube is subjected to nine *additional* and *final* tests for vital characteristics — tests so stringent that nothing short of absolute perfection can survive them! This infinite care in manufacture has won for TRĪADS their reputation for superior quality — and has made possible that guarantee that goes with every TRĪAD Tube — a minimum of six months' satisfactory service or a proper adjustment. You can rely on TRĪADS — the tubes backed by an actual Insurance Certificate!

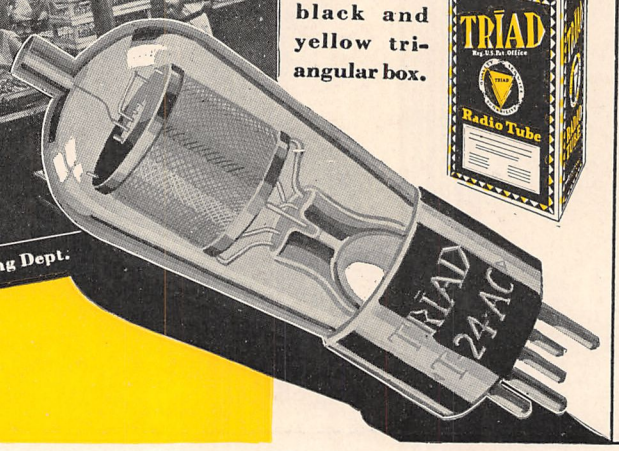
*Call your jobber or write us direct for complete* TRĪAD *information.*

**TRĪAD MFG. CO., Inc., Pawtucket, R. I.**

Tune in on the TRĪADORS every FRIDAY evening, 8 to 8:30 Eastern Daylight Time, over WJZ and associated NBC Stations.

# TRĪAD
## INSURED
# RADIO TUBES

Ask for the tube in the black and yellow triangular box.




## 9 FINAL TESTS

Below are listed the nine *final* tests for vital characteristics to which every TRĪAD Tube is subjected.

1 Gas
2 Emission
3 Filament Current
4 Plate Current
5 Oscillation
6 Grid Voltage
7 Mutual Conductance
8 Plate Impedance
9 Amplification Constant

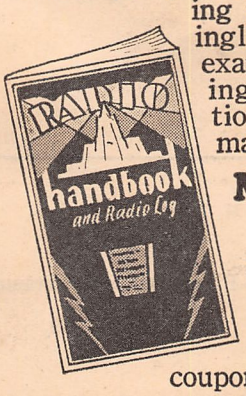
# 4 of the 40 Easy Ways to Make $3.00 an Hour In Your Spare Time in RADIO

THE four plans shown are but a sample of the many ways in which our members are making $3.00 an hour upwards, spare time and full time, *from the day they join the Association.* If you want to get into Radio, have a business of your own, make $50 to $75 weekly in your spare time, investigate the opportunities offered the inexperienced, ambitious man by the Association.

## *Our Members Earning Thousands of Dollars Every Week*

The Association assists men to cash in on Radio. It makes past experience unnecessary. As a member of the Association you are trained in a quick, easy, practical way to install, service, repair, build and rebuild sets—given sure-fire money-making plans developed by us—helped to secure a position by our Employment Department. You earn while you learn, while you prepare yourself for a big-pay Radio position.

The Association will enable you to buy parts at wholesale, start in business without capital, help you get your share of the $600,000,000 spent annually for Radio. As a result of the Association, men all over the country are opening stores, increasing their pay, passing licensed operator examinations, landing big-pay positions with Radio makers.



REDUCE STATIC BY MARVELOUS NEW METHOD
MODERNIZE OLD SETS WITH ONE DIAL CONTROL
IMPROVE TONE AND VOLUME OF OLD SETS
RADIO-FY & ELECTRIFY PHONOGRAPHS

## Mail Coupon Today for the FREE HANDBOOK

It is not only chock-full of absorbing information about Radio, but it shows you how easily you can increase your income in your spare time. Mailing the coupon can mean $50 to $75 a week more for you.

**Radio Training Association of America**
**4513 Ravenswood Avenue Dept. RN-10, Chicago, Illinois**

## Below are a few of the reports from those now cashing in on the "40 Easy Ways"

**Clears $3,000.00** Frank J. Deutch, Pa. — "Since joining the Association I have cleared nearly $2,000.00. It is almost impossible for a young fellow to fail, no matter how little education he has, if he will follow your easy ways of making money."

**$1,100.00 in 6 Weeks** J. R. Allen, Calif. — "Have done over $1,100.00 worth of business in the last 6 weeks. Next month I am going to open up a store of my own. I never knew that money could come so fast and easy."

**$25.00 a Week Spare Time** N. J. Friedrich, N. Y.—"I have averaged $25.00 a week for the last 7 months even though I am not a graduate but just learning."

**Training Lands Him Job** R. C. Kirk, N. C.—"Your training has been very valuable to me. I landed a job with the big department store out here a few weeks ago because I had my membership card with me. There were a large bunch of applications ahead of me."

## ACT NOW
### If You Wish NO-COST Membership

For a limited time we will give to the ambitious man a No-Cost Membership which need not—should not—cost you a cent. For the sake of making more money now, and having a better position in the future, mail coupon below *now.* You'll always be glad you did.

**Radio Training Association of America**
**Dept. RN-10, 4513 Ravenswood Ave., Chicago, Ill.**

Gentlemen: Please send me by return mail full details of your Special No-Cost Membership Plan, and also a copy of your Radio Handbook.

*Name* _____

*Address* _____

*City* _____ *State* _____

# Radio News

Volume XI. CONTENTS FOR OCTOBER, 1929 No. 4

ARTHUR H. LYNCH, Editorial Director

JOHN B. BRENNAN, JR. Technical Editor

W. THOMSON LEES Managing Editor

EDWARD W. WILBY Associate Editor

*Cover*—From a Painting by Howard V. Brown

Frontispiece: Bringing the Mountain to Mahomet ..... 292

Editorial: Radio for Small Pleasure Boats ..... 302

The Magister Tuner ..... 304
By Beryl B. Bryant—Constructional details of a super-DX seven-tube a.c. tuner.

Radio News Floating Laboratory ..... 309
By W. Thomson Lees—The technical staff embarks on some marine-radio experiments.

A 245 Amplifier-Power Supply for the Foundation Tuner ..... 312
By John B. Brennan, Jr.—Constructional details of a compact companion unit to the versatile a.c. tuner described last month.

The Personality Behind the Ghost Hour ..... 316
By Frances Rockefeller King—Dunninger, the magician, and Dunninger, the man.

What Is a Good Loud Speaker? ..... 318
By James Martin—Why the Dynamic stands in the forefront today.

Breaking Into Amateur Transmitting ..... 320
By Lieut. William H. Wenstrom.

The Tube Industry Becomes Big Business ..... 323
By William F. Matthews.

A Compact, Flexible Speech Amplifier ..... 326
By S. Gordon Taylor—A ready source of income for the radio serviceman.

A Compact Receiver for Auto, Plane and Motorboat ..... 329

Call List of Radio Stations of the World ..... 330

This Laboratory Instrument Has Many Uses ..... 338
By George W. Walker.

The Junior Radio Guild ..... 340

1930 Styles and Specifications of Receivers and Speakers ..... 342

The Radio Forum ..... 350
A meeting-place for the Experimenter, Serviceman, and Short-Wave Enthusiast.

(*Advertisers' Index on page* 380)

Published Monthly by the Experimenter Publications, Inc., at 184-10 Jamaica Ave., Jamaica, N. Y.

Member: Audit Bureau of Circulations

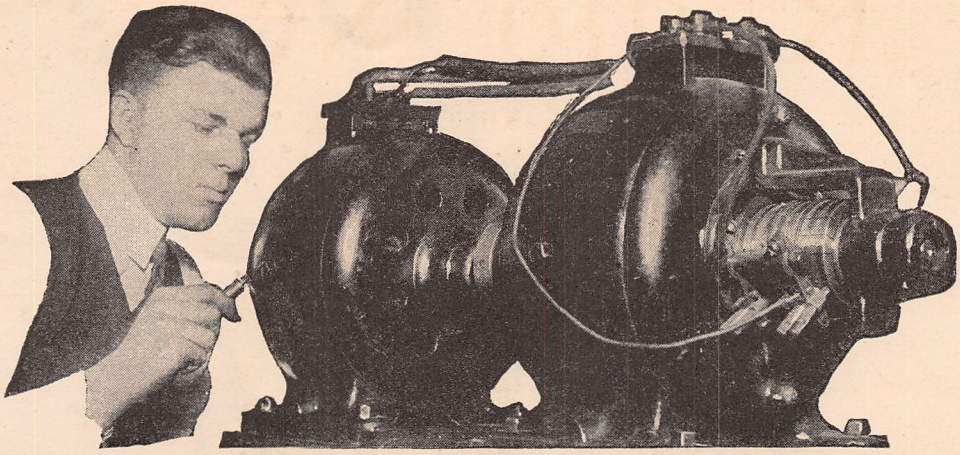
B. A. MACKINNON, President H. K. FLY, Vice-President and Treasurer

Entered as Second-Class Matter at Jamaica, N. Y., under Act of March 3, 1879.

Executive and Editorial Offices, 381 Fourth Ave., New York, N. Y.

RADIO NEWS is published monthly, on the tenth day of each month preceding that of date. Entered as second-class matter at the postoffice, Jamaica, N. Y., under the act of March 3, 1879. Copyrighted 1929 by Experimenter Publications, Inc.; title registered U. S. Patent Office. Subscription price $2.50 a year; $3.00 in Canada and foreign countries. Single copies, 25 cents each. The contents of RADIO NEWS are indexed in the Industrial Arts Index.

EDWARD LANGER PRINTING CO., INC., JAMAICA, N. Y.



# Amazingly Easy Way to get into ELECTRICITY

**Don't spend your life waiting for $5.00 raises in a dull, hopeless job. Now . . . and forever . . . say good-bye to 25 and 35 dollars a week. Let me show you how to qualify for jobs leading to salaries of $50, $60 and up, a week, in Electricity—NOT by correspondence, but by an amazing way to teach, that makes you a practical expert in 90 days! Getting into Electricity is far easier than you imagine! Act now, today!**

## *Learn Without Books* in 90 DAYS

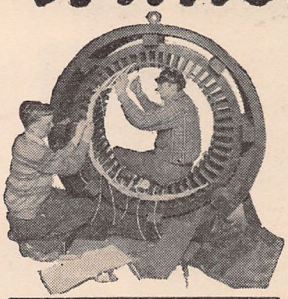
LACK of experience—age or advanced education bar no one. I don't care if you don't know an armature from an air brake—I don't expect you to! I don't care if you're 16 years old or 40—it makes no difference! Don't let lack of money stop you. Most of the men at Coyne have no more money than you have.

### Railroad Fare Allowed

I will allow your railroad fare to Chicago, and if you should need part-time work I'll assist you to it. Then, in 12 brief weeks, in the great roaring shops of Coyne, I train you as you never dreamed you could be trained . . . on the greatest outlay of electrical apparatus ever assembled . . . costing hundreds of thousands of dollars . . . real dynamos, engines, power plants, autos, switchboards, transmitting stations . . . everything from doorbells to farm power and lighting . . . full-sized . . . in full operation every day!

### No Books—All Actual Work

No books, no baffling charts . . . all real actual work . . . building real batteries . . . winding real armatures, operating real motors, dynamos and generators, wiring houses, etc., etc. That's a glimpse of how we make you a master practical electrician in 90 days, teaching you far more than the average ordinary electrician ever knows and fitting you to step into jobs leading to big pay immediately after graduation. Here, in this world-famous *Parent school*—and nowhere else in the world—can you get such training!



**Prepare for Jobs Like These**

Here are a few of hundreds of positions open to COYNE-trained men. Our free employment bureau gives you lifetime employment service.

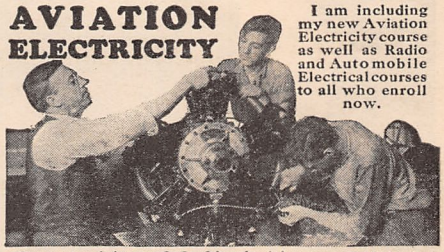
| | |
|---|---|
| Armature Expert | up to $100 a Week |
| Substation Operator | up to $65 a Week |
| Auto Electrician | $60 a Week and up |
| Inventor | Unlimited |
| Maintenance Engineer | up to $100 a Week |
| Service Station Owner | $60 a Week and up |
| Radio Expert | $60 a Week and up |

### Jobs, Pay, Future

Don't worry about a job, Coyne training settles the job question for life. Demand for Coyne men often exceeds the supply. **Our employment bureau gives you lifetime service.** Two weeks after graduation, Clyde F. Hart got a position as electrician with the Great Western Railroad at over $100 a week. That's not unusual. We can point to Coyne men making up to $600 a month. $60 a week is only the beginning of your opportunity. You go into radio, battery or automotive electrical business for yourself and make up to $15,000 a year.

**AVIATION ELECTRICITY**

I am including my new Aviation Electricity course as well as Radio and Automobile Electrical courses to all who enroll now.



*Students wiring and checking ignition on one of the late type Radial Aircraft Engines in our aviation department.*

### Get the Facts

Coyne is your one great chance to get into electricity. Every obstacle is removed. This school is 30 years old—Coyne training is tested—proven beyond all doubt—endorsed by many large electrical concerns. You can find out everything absolutely free. Simply mail the coupon and let me send you the big, free Coyne book of 150 photographs . . . facts . . . jobs . . . salaries . . . opportunities. Tells you how many earn expenses while training and how we assist our graduates in the field. This does not obligate you. So act at once. Just mail coupon.

**Get this FREE Book**

Mr. H. C. LEWIS, Pres.
**COYNE ELECTRICAL SCHOOL Dept. 79-27**
**500 S. Paulina St., Chicago, Ill.**

Dear Mr. Lewis: Without obligation send me your big free catalog and all details of Railroad Fare to Chicago, Free Employment Service, Aviation Electricity and Automotive Electrical Courses and how I can "earn while learning."

*Name*.....

*Address*.....

*City*.....*State*.....

**COYNE ELECTRICAL SCHOOL**
**H. C. LEWIS, Pres.** ***Established 1899***
**500 South Paulina Street** **Dept. 79-27, Chicago, Illinois**

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# Bringing *the* Mountain *to* Mahomet

HERE is Floyd Gibbons, well-known writer, with a portable short-wave transmitter, giving a running account of events in connection with the arrival of the *Graf Zeppelin* at Lakehurst, August 4; his voice being picked up and rebroadcast over a nation-wide hook-up. Two men, with ten-foot poles, carried his antenna system.

# FREE!

# MEN! Here's the dope you've been looking for

## HOW TO GET INTO THE RADIO BUSINESS—

J.E.S.

## Many Earn $50 to $250 a Week in Work That is Almost Romance

If you're earning a penny less than $50 a week, clip coupon now for FREE BOOK! New 64-page book pictures and tells all about the Radio business, hundreds of opportunities—in work that is almost romance! YOU can learn quickly and easily at home, through my tested, proved methods, to take advantage of these great opportunities! Why go along at $25, $35, or $45 a week when you can pleasantly and in a short time learn how to hold the big-pay job?

### Clip Coupon for Free Book

Don't envy the other fellow who's pulling down the big cash! My proven home-study training methods make it possible for you, too, to get ready for better jobs, to earn enough money so you can enjoy the good things of life. One of the most valuable books ever written on Radio tells how—interesting facts about this great field, and how I can prepare you in your spare time at home to step into a big-pay Radio job. GET THIS BOOK. SEND COUPON TODAY.

**J. E. SMITH, Pres.**
**National Radio Institute**
**Dept. 9XTT**
**Washington, D. C.**

## I Give You 6 Big Outfits of Radio Parts

With them you can build 100 different circuits—learn the "how" and "why" of practically every type of Radio set made. This kind of training fits you to step into the good jobs—sends you out an experienced Radio expert. When you complete, my Employment Department will help you to get a real big Radio job like Graduate Edward Stanko, now chief operator of Station WGR, or Frank M. Jones, 922 Guadalupe St., San Angelo, Texas, builder and operator of Station KGFI and manager of the best equipped Radio shop in the southwest, or help you start a Radio business of your own like Richard Butler, 1419 N. 17th St., Philadelphia, Pa., who made around $500 a month compared with a small salaried, no future job as a motorman when he enrolled.

### My Radio Training is the Famous "Course That Pays for Itself"

Spare time earnings are easy in Radio almost from the time you enroll. G. W. Page, 1807 21st Ave. S., Nashville, Tenn., made $935 in his spare time while taking this course. Al Johnson, 1409 Shelby St., Sandusky, Ohio, $1,000 in four months, and he didn't know the difference between a condenser and a transformer when he enrolled. I'll give you a legal contract, backed by N. R. I., pioneer and largest home-study Radio school in the world, to refund every penny of your money if you are not satisfied, upon completing, with the lessons and instructions received. Find out what Radio offers you—get the facts. Mail coupon—RIGHT NOW.

*I Have Trained Hundreds of Men at Home for Big Radio Jobs. My Book Proves I Can Do the Same for You.*

Radio Needs Trained Men

**J. E. Smith, President, National Radio Institute, Dept. 9XTT, Washington, D. C.**

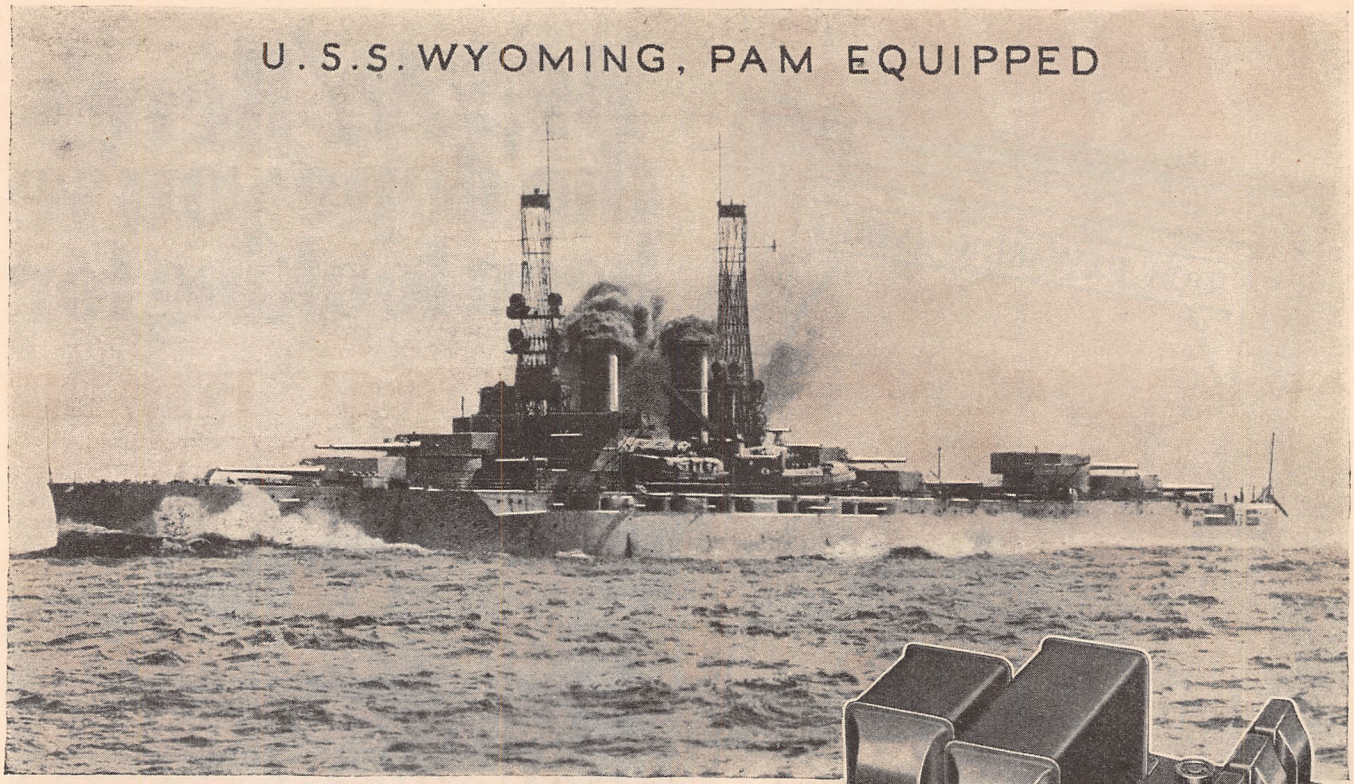
Dear Mr. Smith: Without obligating me in any way, send me your big FREE BOOK, "Rich Rewards in Radio," and all information about your practical home-study Radio Course.

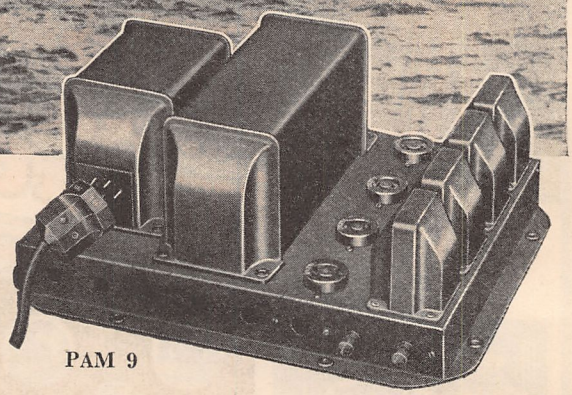
Name.....Age.....

Address.....

Town.....State.....

**ACT NOW—COUPON BRINGS MY FREE BOOK**





PAM 9

# PAM

## Accompanies the Big Guns

Where important events are staged, in this and many other countries, you will find Samson PAM Amplifiers providing entertainment and instruction through loud-speaker systems.

Not only on battleships, but on coastwise vessels and excursion steamers —probably in your neighborhood— are opportunities for such installations.

Truly these are opportunities for worth-while profits from the sale of PAMS and associated equipment, such as radio sets and loud speakers, phonographs and pick-ups, microphones and wiring.

A new 16-page bulletin giving mechanical and electrical characteristics, representative installations, and many new PAM Amplifiers will be sent upon receipt of 10c in stamps to cover postage. When writing ask for Bulletin No. RN3.

*Main Office:*
Canton, Mass.

Samson Electric Co.

MEMBER RMA

*Manufacturers Since 1882*

Factories at Canton and Watertown, Mass.

# With EVEREADY RAYTHEON 4-PILLAR Tubes, you can get the MOST from your present radio receiver

PEOPLE in all parts of the country are telling of the greater power, increased distance, improved tone, and quick action of these remarkable new tubes. The reason is that Eveready Raytheons are built stronger—immune to the bumps and jolts of shipment and handling. They come to you in as perfect condition as when they leave our laboratory test room.

The Eveready Raytheon 4-*Pillar construction* is exclusive and patented. Examine the illustration at the bottom of this page. See how the elements of this tube are anchored at eight points.

This is of particular importance in tubes of the 280 rectifier and 224 screen-grid type which have heavier elements, and in tubes used for push-pull audio amplification, where uniform characteristics are most essential. Eveready Raytheon 4-*Pillar* Tubes come in all types. At your dealer's. He also has the famous B-H tube for "B" eliminator units.

NATIONAL CARBON CO., INC.
*General Offices:* New York, N. Y.
*Unit of Union Carbide* UCC *and Carbon Corporation*

*Showing the exclusive, patented Eveready Raytheon* 4-Pillar construction. *Note the sturdy four-cornered glass stem, the four heavy wire supports, and the bracing by a stiff mica sheet at the top.*

*Eveready Raytheon Screen-Grid Tube,* ER 224. *Without Eveready Raytheon's* 4-Pillar construction, *this type of tube is delicate, liable to severe damage in shipment.*

EVEREADY RAYTHEON

Trade-marks

# 4 SCREEN-GRID TUBES AND POWER-DETECTION!

### *Screen-Grid Performance*

Screen-Grid Tubes have opened the door to an altogether new kind of distance-performance in Radio. The new NATIONAL MB-29 Screen Grid Tuner uses 4 A. C. Screen-Grid tubes.

### *Why Power Detection?*

The latest and biggest improvement in Broadcasting is the use of High-Percentage-Modulation, now employed by the newest and finest stations. Soon all stations of any importance will adopt it, because of the better transmission it permits.

This improvement is not particularly noticeable with receivers using the older forms of detection. But we have just developed a system of Power-Detection especially designed to secure proper reception from stations using High Percentage Modulation and this is now offered for the first time, in the MB-29.

### *Band-Selector Tuning*

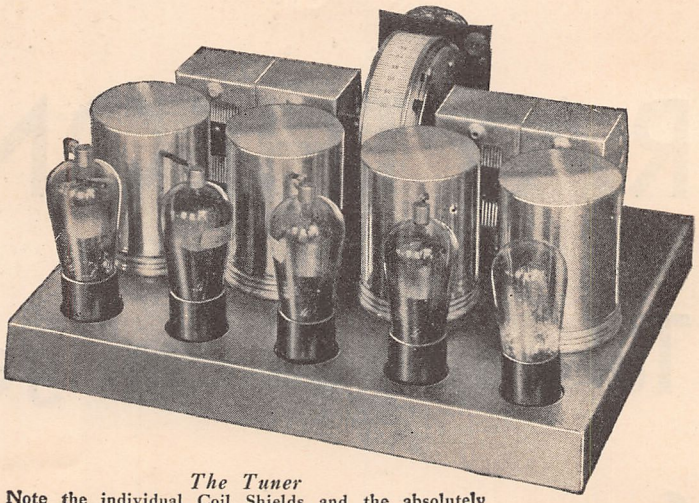
Band-selector tuning assures sharp separation between stations, and, at the same time, finest quality of reproduction, because with the "open window" of the tuning curve, side-bands are not cut.

### *A Magnificent Chassis*

With its completely shielded aluminum chassis, precision matched coils and latest NATIONAL Weld-Built Condensers—with its modernist NATIONAL *Projector* Dial—this tuner makes possible the construction of a magnificent A. C. receiver which combines the cleancut finish and appearance of the finest factory-built model with the quality and perfection of a custom-built job.

### *The Velvetone Amplifier Power Supply*

For use with the MB-29 Tuner is the specially designed NATIONAL Velvetone Amplifier, a complete Amplifier-Power Supply, using two UX245's in push-pull and



*The Tuner*
Note the individual Coil Shields and the absolutely cleancut appearance.

equipped with phonograph jack. This amplifier is licensed under patents of R. C. A. and Associated Companies and is sold fully wired and ready for use (less tubes).

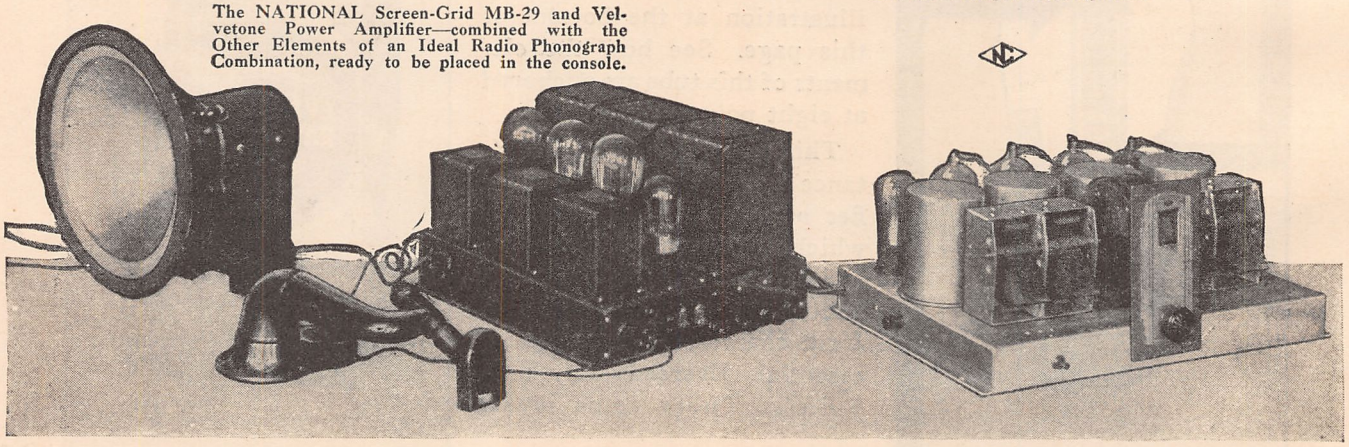
### *Consoles and Tables for the MB-29*

There are available a selection of beautifully finished and specially priced consoles and tables for housing the MB-29 in various popular combinations.

The MB-29 bristles with new and ingenious features for your convenience and pleasure. *Write us today for full information, mentioning Radio News.*

**NATIONAL COMPANY, INC.**
**ENGINEERS & MANUFACTURERS**
**61 SHERMAN ST., MALDEN, MASS.**
EST. 1914 . .W.A. READY, PRES.

The NATIONAL Screen-Grid MB-29 and Velvetone Power Amplifier—combined with the Other Elements of an Ideal Radio Phonograph Combination, ready to be placed in the console.



**NATIONAL**
**« SCREEN-GRID » --**
***Ask Us About It. Write Us Today.***

**MB-29**

# SM

# New S-M Custom Receiver Designs Shatter All Records

## Single Control

Perfect convenience in operation, with a tremendous gain in selectivity and sensitivity—that's what has been accomplished in the new S-M receivers. Newly developed shielded coils make possible, with straight single control, a degree of selectivity never before achieved, *even with multiple controls or verniers.* One tuning control, one volume control, an on-off switch—that's all. All these receivers have push-pull 245 output stages, and both broadcast receivers embody the latest band-selector tuning.

## All-A. C. Operation

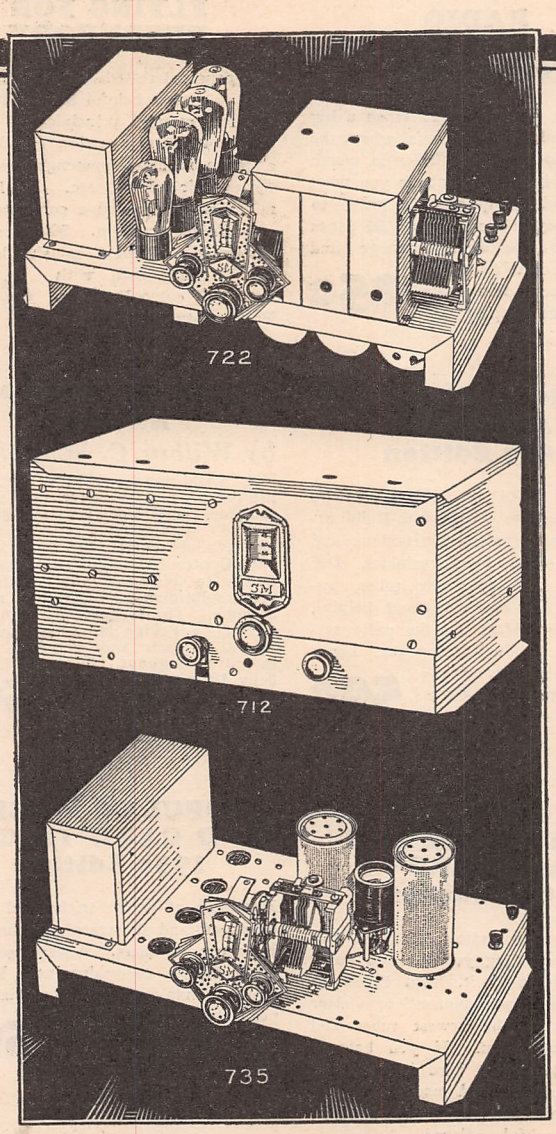
These receivers are *absolutely all-electric*—even the 735 short-wave set, the first of its kind ever offered on the market. Power supplies are *built into* the receivers—not separate. The *full* advantages of the new a. c. screen-grid tubes are secured. The characteristic superior S-M tone quality, distance-range, and selectivity are in these receivers as never before, due not alone to band-selector tuning but also to still greater refinements of design and accuracy of manufacture.

## S-M Speakers and Power Amplifiers

Nothing more beautiful in sound reproduction has ever been heard than the new S-M dynamic speakers, when supplied from a powerful S-M push-pull audio amplifier—giving straight-line amplification from 5000 cycles down even to below 50. These new medium-voltage high-power two-stage amplifiers, using 245 tubes in push-pull are built into the 722 and 735, and an extra high-grade Clough-system amplifier is obtainable separately, as the 677.

## Beautiful Cabinets

The handsome new 707 table model shielding cabinet, finished in rich crystalline brown and gold, suitable for 722, 735, or 735DC, is only $7.75. Special arrangements have been made whereby these receivers may be housed in magnificent consoles especially adapted to them. Be sure to send for the new Fall S-M General Parts Catalog, for details of these cabinets.




## 722 Band Selector Seven

Providing practically all 1930 features found in most new $200 receivers, the S-M 722 is priced absurdly low in comparison. 3 screen-grid tubes (including detector), band-filter, 245 push-pull stage—these help make the 722 *the* outstanding buy of the year at $74.75 net, completely wired, less tubes and cabinet. Component parts total $52.90. Tubes required: 3—'24, 1—'27, 2—'45, 1—'80.

## 712 Tuner

Far more selective and sensitive even than the Sargent-Rayment 710, the new single-control 712 with band-filter and power detector stands far beyond competition regardless of price. Feeds perfectly into any audio amplifier. Tubes required: 3—'24, 1—'27. Price, only $64.90, less tubes, in shielding cabinet. Component parts total $40.90.

## 677 Amplifier

Superb push-pull amplification is here available for only $58.50, less tubes. Ideal for the 712. Tubes required: 2—'45, 1—'27, 1—'80. Component parts total $43.40.

## 735 Short-Wave Receiver

A screen-grid r. f. stage, new plug-in coils covering the bands from 17 to 204 meters, regenerative detector, a typical S-M audio amplifier, all help to make this first a. c. short-wave set first also in performance. Price, wired complete with built-in power unit, less cabinet and tubes, only $64.90. Component parts total $44.90. Tubes required: 1—'24, 2—'27, 2—'45, 1—'80. Two extra coils, 131P and 131Q, cover the broadcast band at an extra cost of $1.65.

Adapted for battery use (735DC) price, $44.80, less cabinet and tubes. Component parts total $26.80. Tubes required: 1—'22, 4—'12A.

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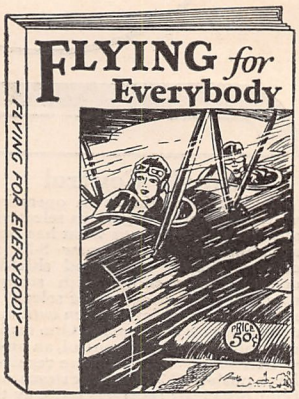


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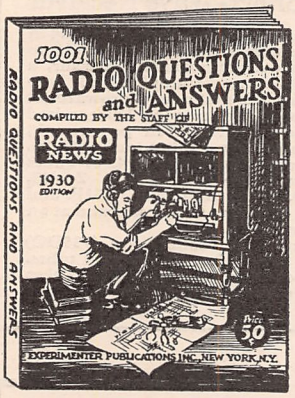
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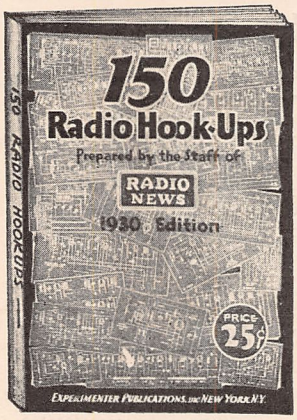


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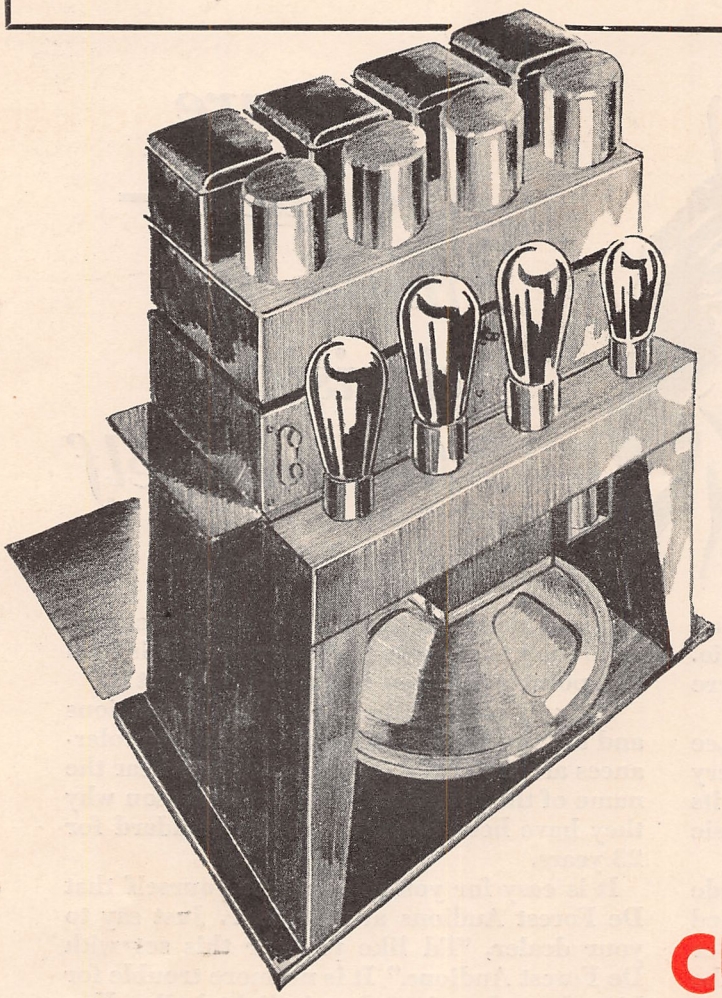

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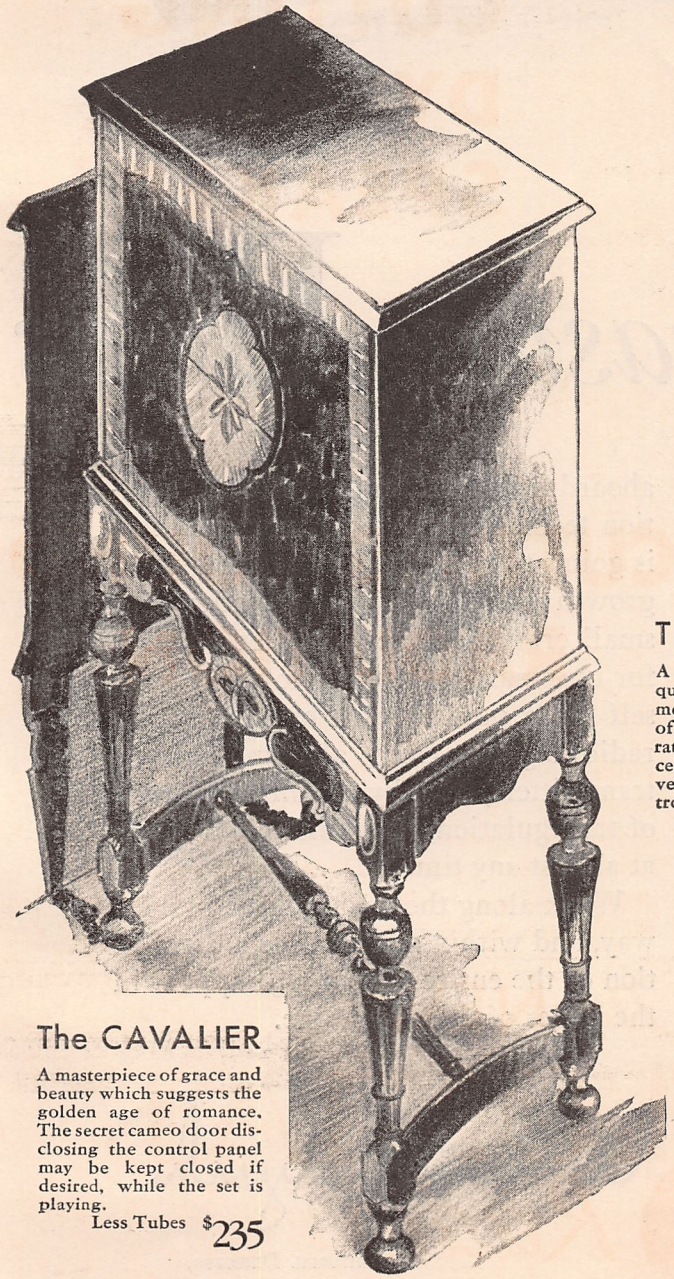

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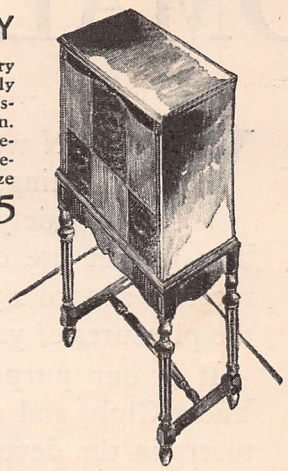

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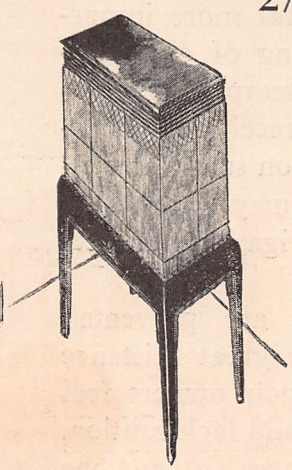

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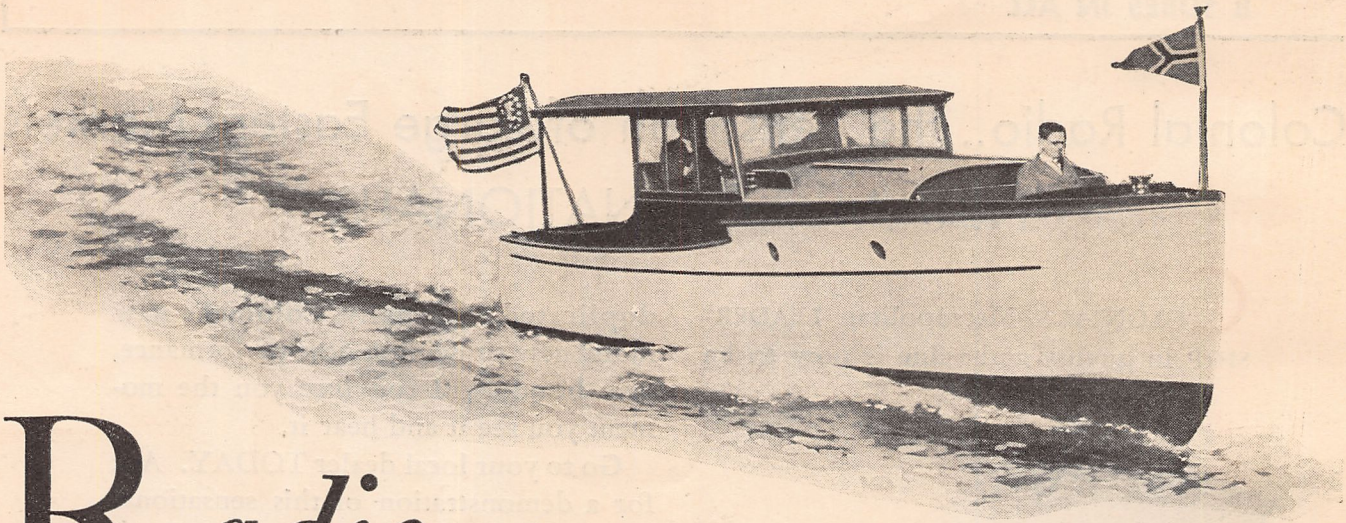
# Editorial



# Radio for Small Pleasure Boats

WHEN we think of yachts and yachting, we naturally think of gaiety and entertainment. The proper use of a radio broadcast receiver aboard a yacht adds greatly to the pleasures of yachting.

It is our purpose to assist various Yacht Clubs and motor boat manufacturers in the development of an additional radio feature, far more important than the providing of entertainment alone. We contemplate the development of radio receiving equipment suitable for use on small as well as large boats, which may be used for entertainment and navigation purposes as well.

Many small boats are prevented from venturing any great distance from shore because their owners feel that such a venture would lack caution, particularly when there is no one aboard who is familiar with navigation technique. The aviation industry is going to be largely responsible for a growth in deep sea navigation for small craft, because it will be possible for the small-boat owner to guide himself from port to port by picking up radio signals from airplane beacon transmitters, and by a simple process of triangulation determine his location at almost any time.

Work along these lines is well under way, and within a short time a description of the entire system will appear in the pages of this magazine.

Arthur H. Lynch

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# Complete Constructional Details

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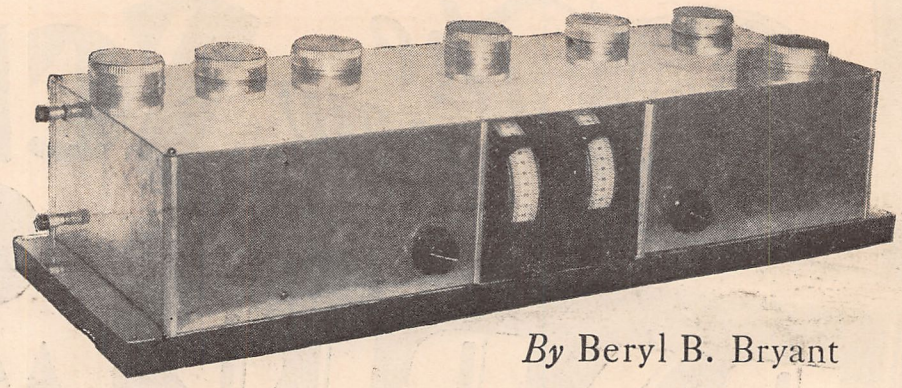


*By* Beryl B. Bryant

# *Seven Tube* MAGISTER *Tuner*

THE writer prefers broadcast reception from stations outside the sphere of the local broadcast area. There are many reasons for this preference.

Consistent reception of distant broadcast stations on the loud speaker requires a powerful receiver. The selectivity must, of course, be in equal proportion to the amplification, yet must not produce distortion by side-band cut-off. To the writer, with the receiver described here, using a not-to-good antenna, medium powered stations located within a radius of three to four hundred miles are considered as locals. If the reader cares to investigate, he will find but very few receivers that are capable of consistent DX reception on the loud speaker, not to mention the lack of super-DX reception. He will not find such receivers to possess a sufficient degree of selectivity without side band cut-off to prevent the interference of locals.

With these things in mind, many trials and experiments were conducted before the final type of circuit and construction design was adopted. In passing, the author might mention that the "Home Builder's Seven," described in the April issue of RADIO NEWS, was the result of one of these experiments. It is remarkable to note the DX qualities of such a simple receiver as compared to the intricate works of receivers having the same qualities for DX. The writer might further mention that the greatest distance reception, of fair loud speaker volume, has been that of station JOAK of Japan. This was accomplished by one of the editors of SCIENCE AND INVENTION, who has confirmation of this reception. Other builders and friends report consistent reception of stations located on the west coast, Mexico, Havana, etc.

Thus the evolution of the receiver-tuner presented here has been after a long period of careful experimental work. The author believes this receiver, of most modern custom-built type, to be far superior to the many commercial receivers of similar type. Because of this belief the author has named the receiver the "Magister" (Latin for Master).

Inspection of the circuit diagram (Fig. 0) will show that six of the 224 and one of the 227 type tubes are used.

The first two screen-grid tubes, V1 and V2, beginning at the left of the diagram, are tuned r. f. amplifiers. Their wavelength band extends over 200 to 550 meters. These circuits are not of the band pass type, although they are inductively coupled. Due to the characteristic of the screen-grid tube, the 1:2 primary-secondary winding ratio and type of inductances used, a degree of broad tuning is prevalent. This broad tuning is desirable, purposely brought about to enable ease of tuning over the band without the necessity for the use of compensating condensers to obtain exact resonance at all wave-lengths.

The third screen-grid tube, V3, is used as a new type of modulator. However, a similar circuit has been employed in Europe for some number of years, differing only by characteristics of the tubes. The screen-grid of this tube is modulated by the oscillator and obtains as well its "B" plus potential from the plate of that tube. The manner in which the modulator tube mixes the frequencies is similar and almost identical with the three element modulator of the late R. E. Lacault's Ultradyne circuit. As the screen grid of the tube requires a definite "B" plus potential, its return is made to the plate of the oscillator tube instead of the grid, as in the case of the Ultradyne. The voltage of both the screen-grid and plate are somewhat critical depending upon the r. f. gain of the preceding stages. Using this tube as a modulator gives the advantages of amplification by virtue of plate supply as used with the old first-detector type of mixer and at the same time has the same degree efficiency and sensitivity of modulation as found in the Ultradyne circuit. Before passing on those who may desire to use this type of modulator in the "Home Builder's Seven" may do so with ease, and to great advantage. The normal screen-grid and plate potentials of the tube should be used in this case.

The modulator tube feeds into two screen-grid intermediate-frequency band pass stages of the inductively coupled type. The degree of coupling has been made adjustable for the degree of band pass desired. The intermediate-frequency stages are designed for 250 kilocycles with a from 5,000 to 15,000 cycle band pass. The 1200 meter or 250 kilocycle frequency was selected in order to approach as nearly a possible one spot tuning and to enable ease of construction of the tuned band pass filter inductances at the lowest possible cost.

### *Power Detector*

The sixth screen-grid tube, V7, is of the power detector type using "plate bend" rectification. No provision has been made on the chassis for coupling to the a. f. amplifier other than the detector

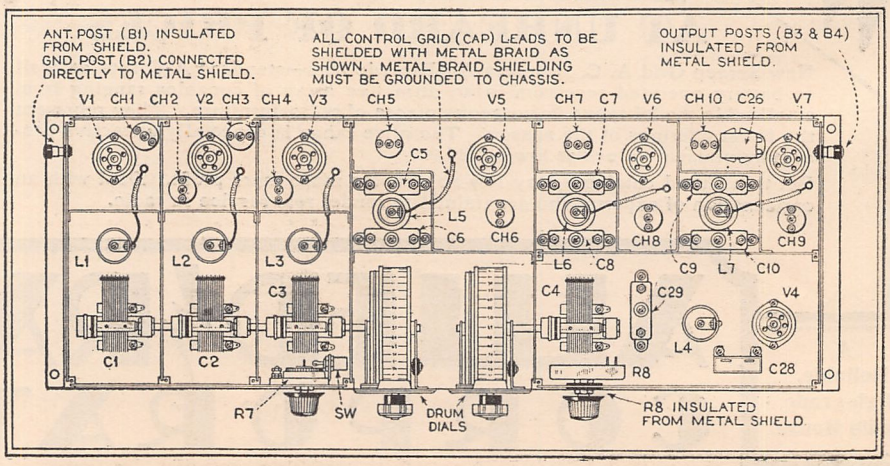
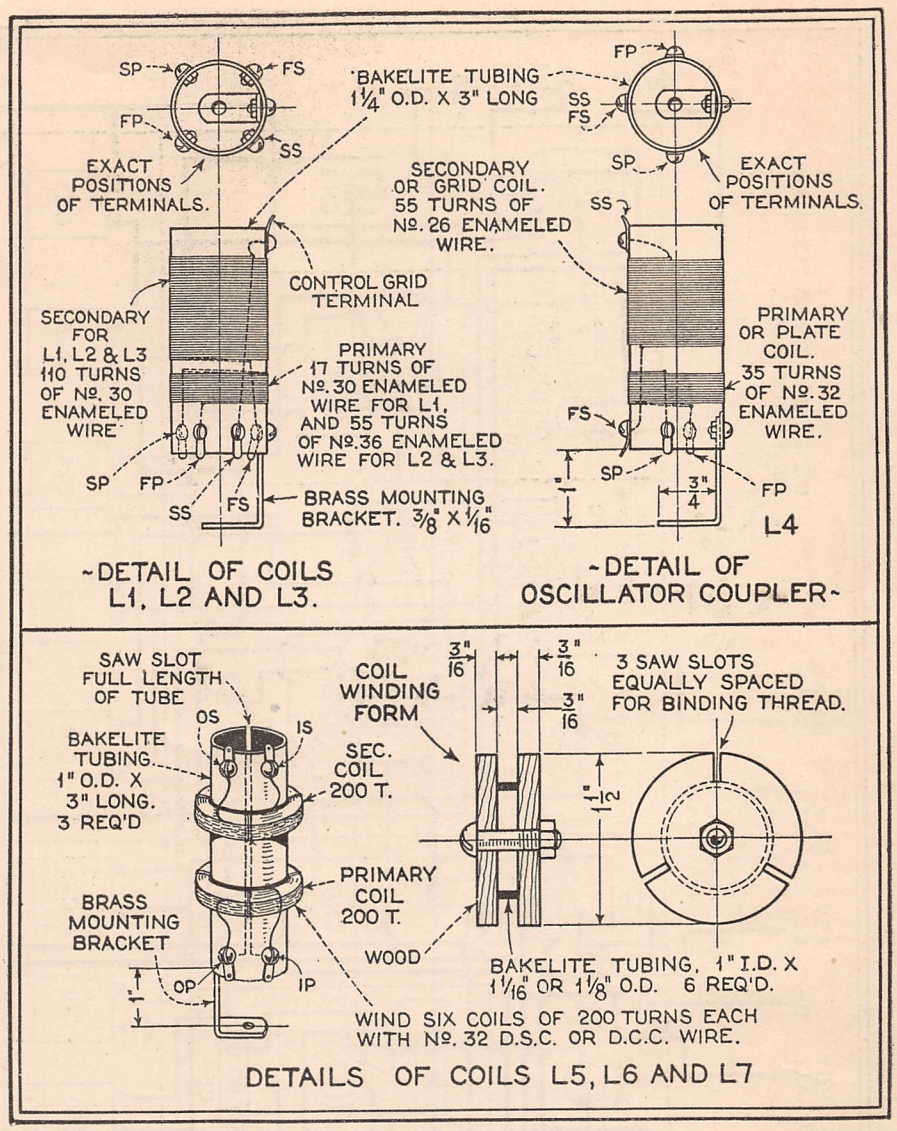



**Fig. 1. In laying out the parts for the Magister it is well to follow the picture layout below and the photographs accompanying**

plate lead. The series plate resistor could of course be incorporated on the chassis but as the complete audio and power system are contained in another chassis, it was not considered advisable because of possible circuit reaction, as doing so would necessarily make the grid lead of the succeeding a. f. stage of considerable length. This would be subject to a great many disturbances as can be seen. With many stations, all locals, it will be possible to eliminate the first a. f. stage, coupling directly to the power stage. Sufficient gain to load the 245 power tube may be had in this manner to supply volume suitable for most home use. The detector plate-feed resistance should have a minimum value of 250,000 ohms. The a. f. return is made to the cathode of the detector through a bypass condenser connected to B4, while the "B" supply is obtained from the power supply in the conventional manner. The detector r. f. by-pass condenser, C 26, is also returned to the same point. A capacity of .001 mfd. is used here for filtering of the high audio frequencies. Should these frequencies be desired, the capacity may be reduced to .0005 mfd. and in some instances a capacity of .00025 mfd. will prove satisfactory. The above returns are not made to "B" minus as is usually the case, as, even though the detector bias resistor is by-passed by a 1 mfd. condenser, C 25, there still remains the reactance of this condenser in the circuit. This reactance would tend to attenuate some of the very low audio frequencies.

### *Suitable Audio-Frequency Amplifiers*

The a. f. amplifier may be of any type, within certain restrictions. In a following issue of this magazine will be described a suitable amplifier and power supply. This amplifier employs one stage using the 227 type tube, coupled to the detector through the proper grid blocking condenser, in connection with


SP
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EXACT POSITIONS OF TERMINALS.
BAKELITE TUBING 1¼" O.D. X 3" LONG
CONTROL GRID TERMINAL
SECONDARY FOR L1, L2 & L3 110 TURNS OF No. 30 ENAMELED WIRE
PRIMARY 17 TURNS OF No. 30 ENAMELED WIRE FOR L1, AND 55 TURNS OF No. 36 ENAMELED WIRE FOR L2 & L3.
BRASS MOUNTING BRACKET. 3/8" X 1/16"
~DETAIL OF COILS L1, L2 AND L3.
SECONDARY OR GRID COIL. 55 TURNS OF No. 26 ENAMELED WIRE.
PRIMARY OR PLATE COIL. 35 TURNS OF No. 32 ENAMELED WIRE.
L4
~DETAIL OF OSCILLATOR COUPLER~
SAW SLOT FULL LENGTH OF TUBE
BAKELITE TUBING. 1" O.D. X 3" LONG. 3 REQ'D
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IS
OP
IP
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SEC. COIL 200 T.
PRIMARY COIL 200 T.
BRASS MOUNTING BRACKET
WOOD
3 SAW SLOTS EQUALLY SPACED FOR BINDING THREAD.
BAKELITE TUBING, 1" I.D. X 1 1/16" OR 1 1/8" O.D. 6 REQ'D.
WIND SIX COILS OF 200 TURNS EACH WITH No. 32 D.S.C. OR D.C.C. WIRE.
DETAILS OF COILS L5, L6 AND L7

Fig. 2. Full constructional details for all the coils employed in the tuner are given above. Compare the terminal markings with the schematic circuit shown in Fig. 3

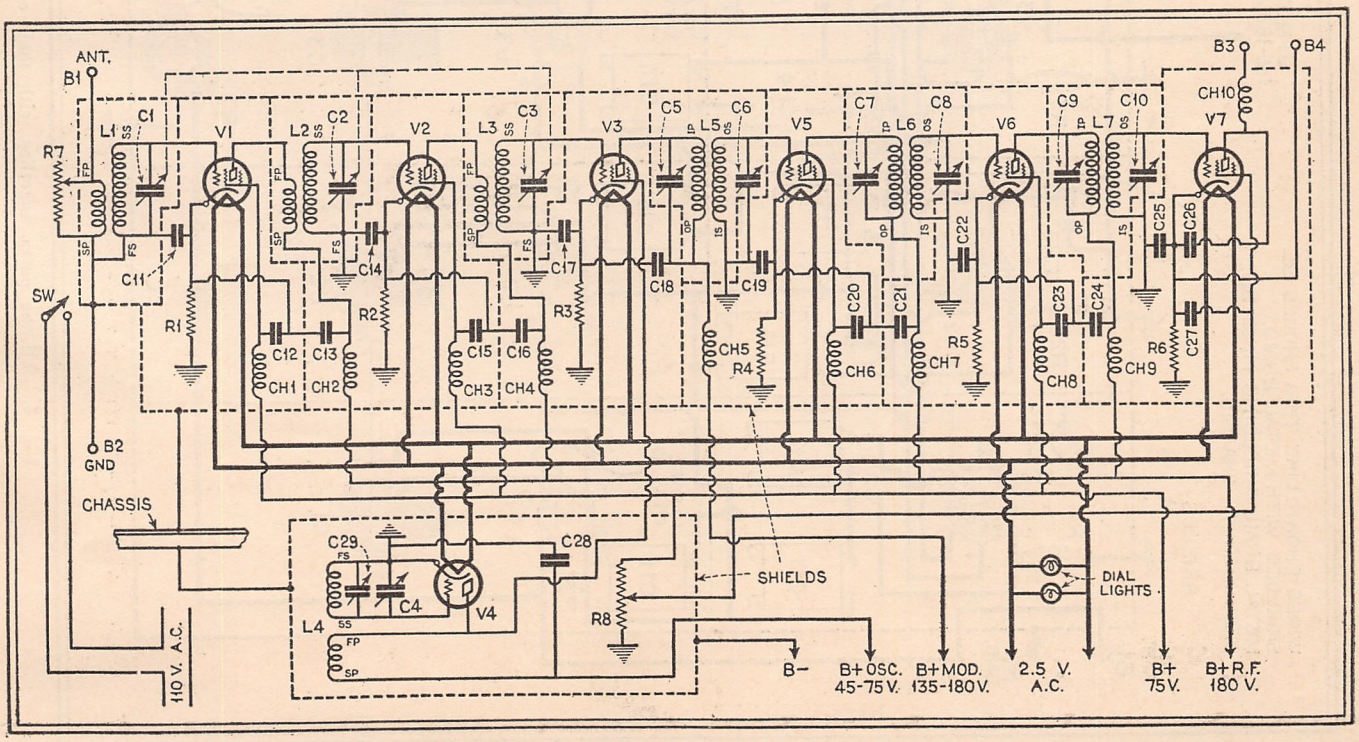



Fig. 3. Here is given the complete circuit diagram for the Magister tuner. The parts are numbered to coincide with the parts layout and parts list

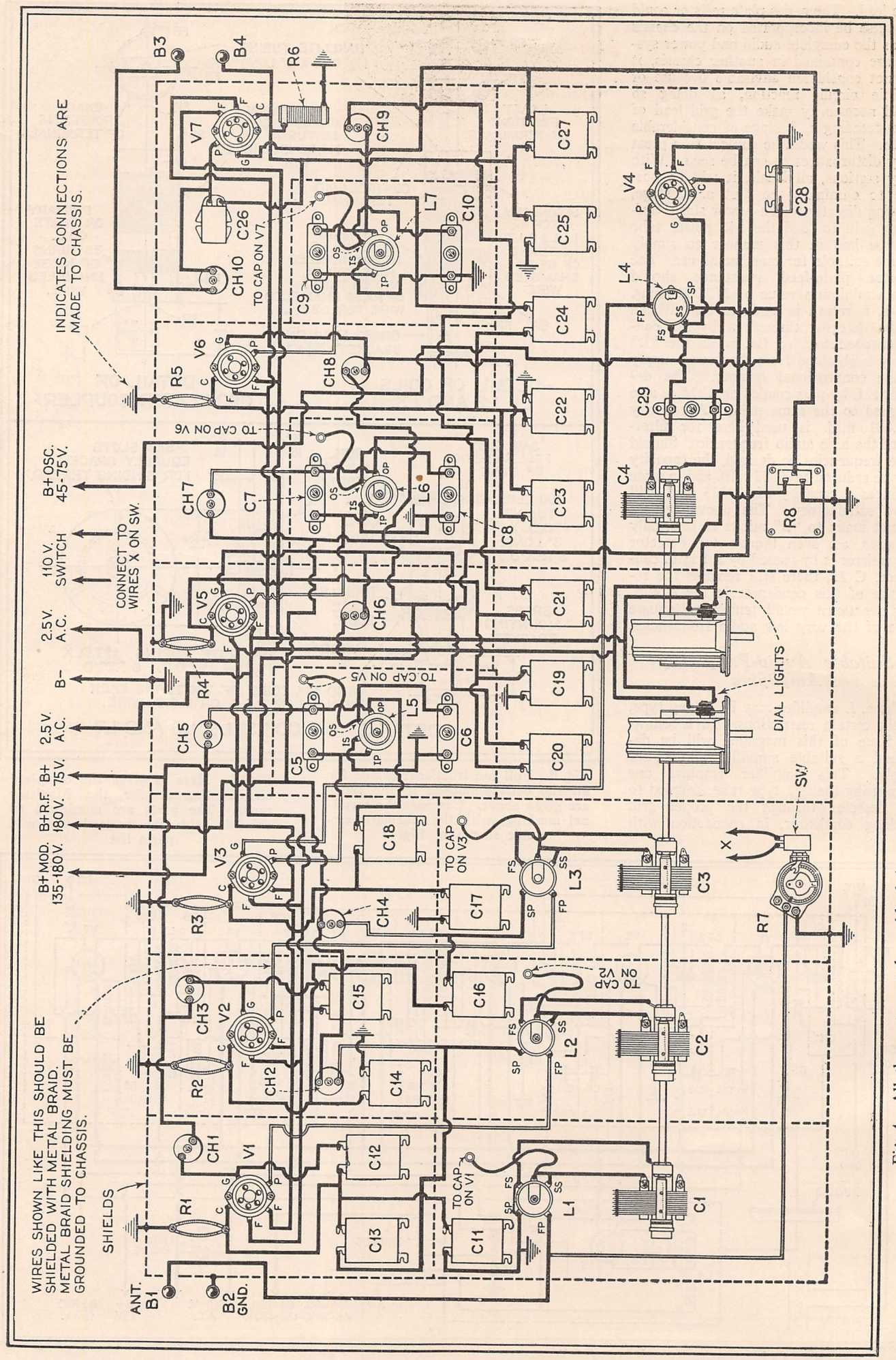
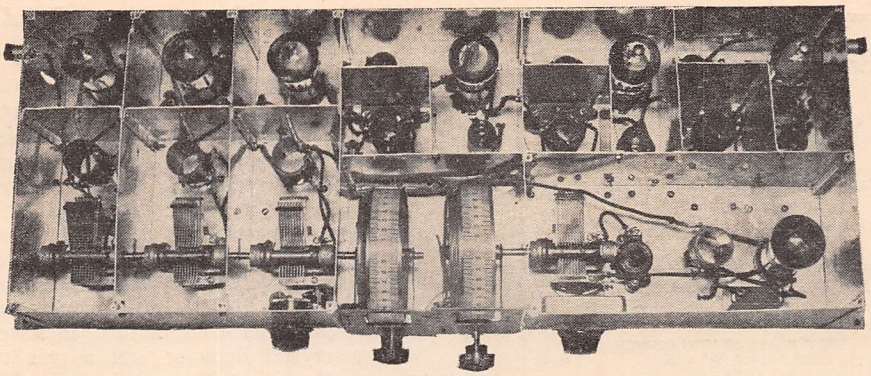



Fig. 4. All the parts, together with their connecting wires, are shown in the relative positions they will take in the completed set



How the Magister looks when completely built

the detector plate-feed resistor. The first a. f. stage is followed by a push-pull stage in which the general purpose power tube, the 245 type, is employed. Such a combination when used with the r. f. amplifier-tuner described here will deliver more than ample power for ordinary purposes and serves to lessen the cost of the complete receiver.

### *Mechanical Construction*

The chassis construction of the "Magister" is of improved design and is simple in construction. It is constructed of such material that lends great strength to the assembly, serving as a base of support and common electrical connection. The aluminum shield compartments have been built as a part of the chassis. The bottom of the shield compartments is a single large piece of aluminum the same thickness as used for the partitions, sides and top.

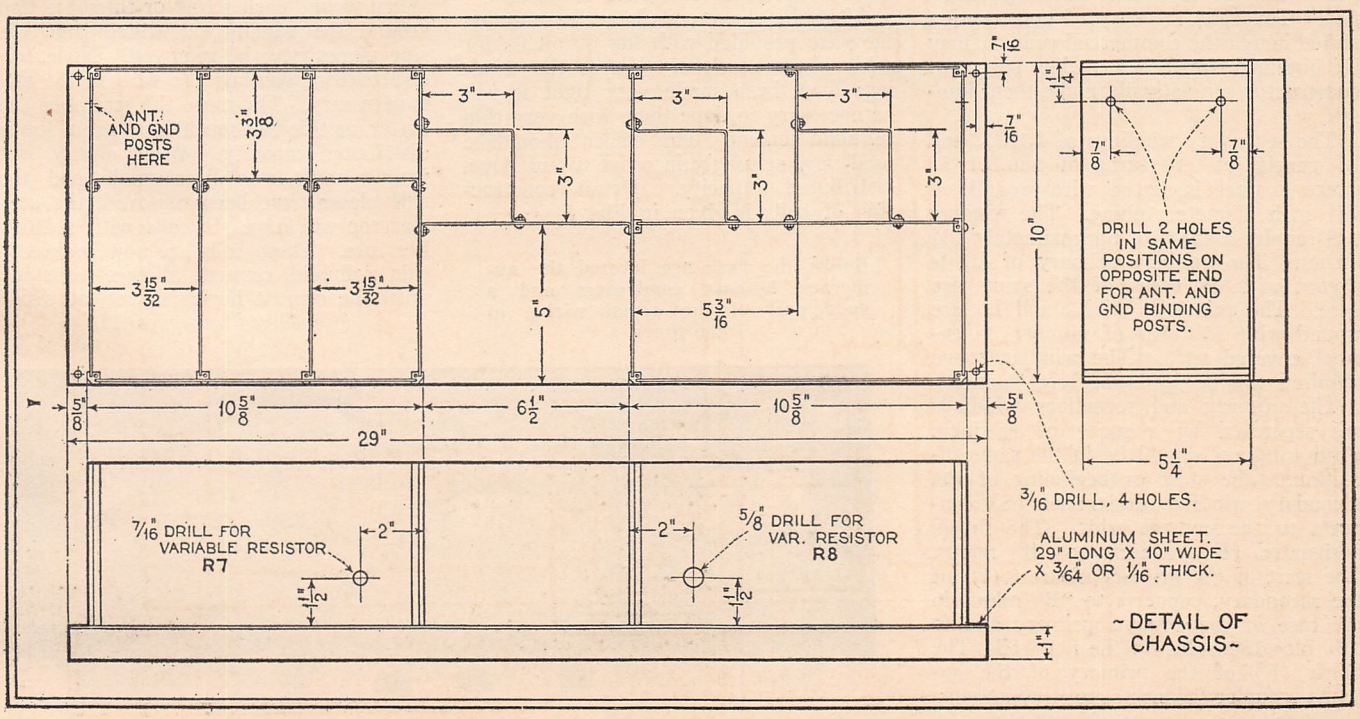
### *Selection of Parts*

While the constructor will naturally desire to use what parts he may happen to have on hand that will fit into the circuit, it is recommended that rather than chance possible trouble, the parts listed below be purchased new and triple tested as to defects. These parts have been selected with both a view toward the expense, and to their efficiency of operation in the circuit. Size in many cases has also been a factor for selection.

However, should different parts be used, care should be taken that additional space be allowed for them when building up the chassis. The chassis has been made as small as possible; as a matter of fact has been built around the parts. The parts required for duplication of the official "Magister" tuner are as follows:

Four Hammarlund .00035 mfd. tuning condensers (C1 to C4).
Two National drum dials, type F.
Ten Pilot 80 millihenry chokes. Inductances smaller than these are worthless in the Intermediate stages (Ch1 to Ch10).
Seven Pilot UY sockets, type 217 (V1-V2-V3-V4-V5-V6-V7).
Seventeen Flectheim 1 mfd. by-pass condensers-250 volt d. c. rating (C11 to C25, C27 and C28).
One .001 mfd. Flectheim midget fixed condenser (C26).
One Antenna Coupler, home-made or commercial (L1).
One Oscillator Coupler (L4).
Two Screen-grid r. f. couplers, home-made or commercial (L2 and L3).
Three Intermediate band-filter transformers (L5, L6 and L7).
Six XL Laboratories Vario-densers, type G5 (C5 to C10).
One XL Laboratories Vario-densers, type G1 (C29).
One Electrad 50,000 ohm Truvolt fixed resistor with tap for detector bias (R6).
Ten Electrad 1400 ohm grid suppressors for Screen grid tube bias. (Important see paragraph on tubes.) (R1-R2-R3-R4-R5.)
One Electrad volume control type AP (R7).
One Electrad Super Tonatrol No. 5. 0 to 100,000 variable resistor (R8).
Four XL Laboratories "bakelite top" binding posts (B1 to B4).
Six Carter Control grid connector caps.
Six Hammarlund slotted corner posts (obtainable directly from manufacturer).
Six Hammarlund slotted partition posts (obtainable directly from manufacturer).
One sheet aluminum 29 x 10 x 3-64 inches.
One sheet aluminum 27¾ x 10 x 3-64 inches.
Six sheets aluminum 9½ x 5¼ x 3-64 inches.
One sheet aluminum 27¼ x 5¼ x 3-64 inches.
Three sheets aluminum 10⅛ x 5¼ x 3-64 inches.
One sheet aluminum 7⅜ x 5¼ x 3-64 inches.
Three sheets aluminum 6¾ x 5¼ x 3-64 inches.
Three sheets aluminum 4 x 5¼ x 3-64 inches.
One sheet aluminum 5½ x 5¼ x 3-64 inches.
Seven aluminum caps (salt and pepper shakers 2¼" diameter by 3" high, the bottoms of which are used as tube port hole covers).
Six Speed type 224 tubes, new type (see paragraphs on tubes). (V1-V2-V3-V5-V6-V7.)
One Speed type 227 tube (V4).
Four pieces bakelite tubing 1¼ inches in diameter by 3 inches long (for L1, L2, L3 and L4).

Fig. 5. Not only the coils, but also the tubes are located in shielded compartments, laid out as shown here



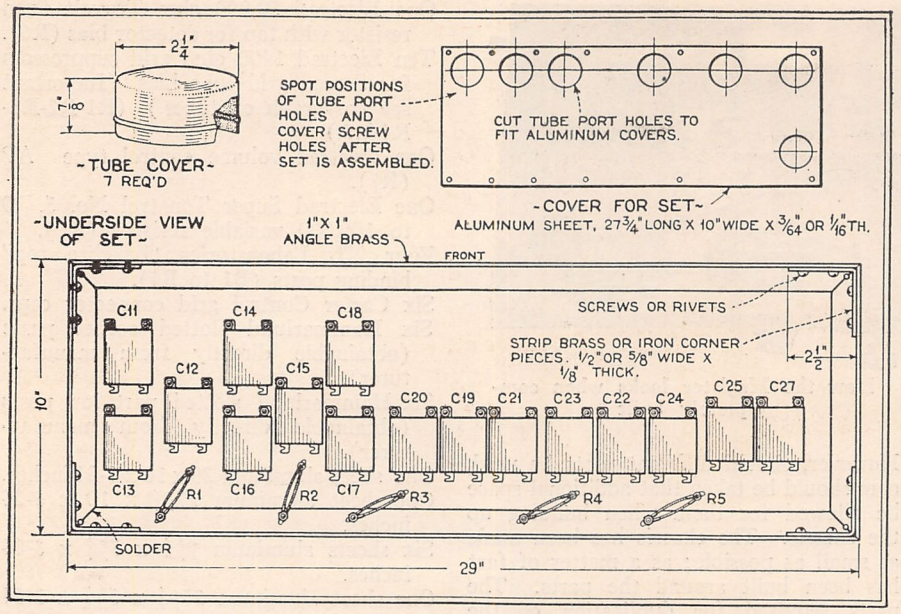



**Fig. 6. Details for mounting the various by-pass condensers, location of the tube caps, etc., are given above**

Three pieces bakelite tubing one inch in diameter by 3 inches long (for L5, L6, and L7).

Six bakelite rings one inch in diameter by 3-16 wide (core pieces for coils of L5, L6 and L7).

Two pieces angle brass 29¾ inches long by 1 inch by ⅛ inch thick.

Two pieces angle brass 10 inches long by 1 inch by ⅛ inch thick.

Four iron corner angles ½ inch wide ⅛ inch thick and 2½ inches long.

### *Construction of Coils*

The antenna and r. f. coils used in the "Magister" must be of the small field, small diameter type in order that coupling between the r. f. stages is minimized. Otherwise the shielding would prove to be inadequate. Various commercial coils may be obtained on the market that will prove satisfactory when properly modified. The coils are easy of construction and although the commercial product may be obtained for a reasonable cost, the constructor can as easily make them himself.

The secondary windings of L1, L2 and L3 consist of 110 turns of number 30 gauge enamel insulated wire wound on 1¼ inch diameter tubing. The winding will require a space of approximately 1¼ inches. The antenna primary of L1 is wound with 17 turns of the same size wire. The primaries of L2 and L3 are wound with 55 turns of number 36 enamel covered wire. The winding space required will be approximately ⅜ inch.

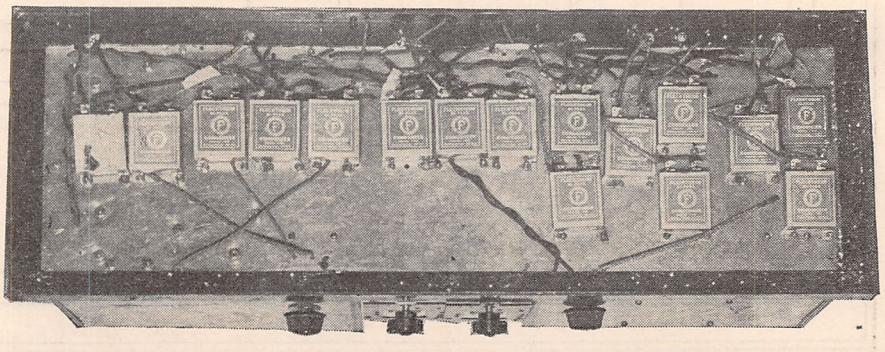
The primary and secondary windings are separated by a space of ⅛ inch. Both windings should be in the same direction. The start or beginning of the secondary winding, designated (S) connects to the control grids. The finish, designated (F) connects to "B" minus. The start of the primary, nearest (F) of the secondary, connects to "B" minus in the case of the antenna primary and to "B" plus 180 volts for the r. f. coils. The finish (F) of the primary of the antenna coupler connects to the antenna binding post (B1) and also to the antenna volume control (R7). The finish of the RF primaries connects to the plate of the tubes.

### *Special Oscillator Coupler*

Inasmuch as the wave length range of the oscillator coupler is considerably different from the other coils, this coupler must be constructed by the builder. It is wound on the same diameter tubing as used for the antenna and r. f. coils. The grid or secondary winding consists of 55 turns of number 26 enamel covered wire. The primary or plate coil consists of 35 turns of number 32 enamel covered wire. The two windings are separated by ⅜ inch. The use of smaller wire for the primaries of the above coils has proved more satisfactory, especially in the case of the oscillator coupler. Its use tends to minimize the production of parasite harmonics by the oscillator as well as overcomes unstable generation as is the case when larger size wire is used.

After the above coils have been wound they are provided with lug terminals for soldered connections. Unless the windings have been made very tight it will be necessary to dope them with very thin celluloid cement. This cement should be used very sparingly in order to cut down distributed capacity. Detail construction of coils is given in Fig. 2.

**Below the base are located the numerous by-pass condensers and a good part of the actual wiring of the tuner**



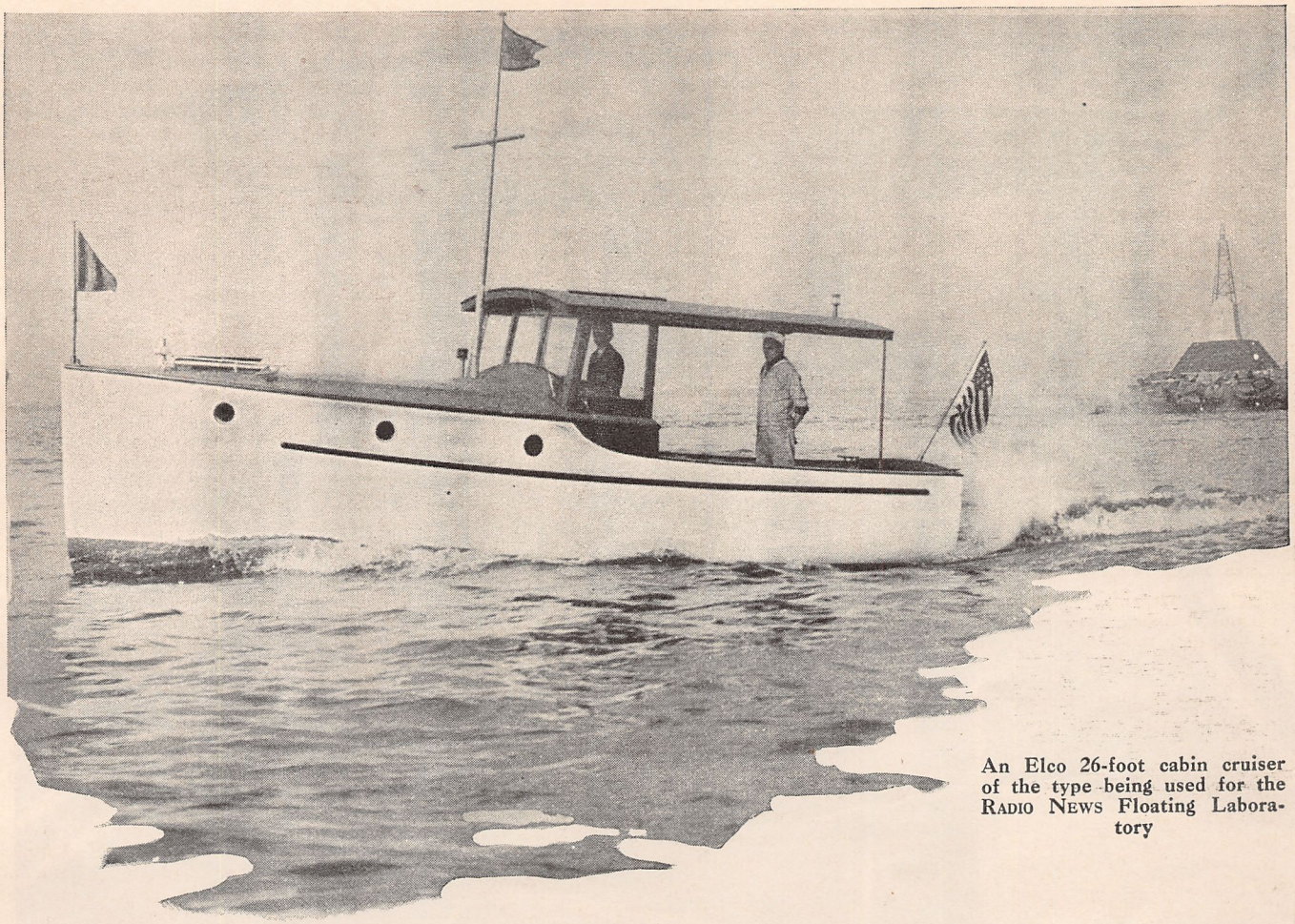
### *Making the Intermediate Band Filter Transformers*

The construction of the coils used for the band filter transformers is very simple While lateral wound coils are desirable, bunched slot wound coils will prove just as satisfactory providing they are carefully made and matched. The latter process may be accomplished by using one of the coils as the grid coil of a modulated Hartley oscillator, and should be shunted by a .00035 mfd. condenser. Placing the other coils in turn, in series with a crystal detector and a pair of phones, the coil to be matched shunted by a .00035 mfd. condenser, the number of turns are adjusted until the signal is loudest. Use of a variable condenser with some sort of scale will expedite this work.

For the coil construction, six bakelite rings one inch in diameter and 3-16 inch in width are required. These rings are clamped, in turn, between side pieces which should have a diameter of not less than 1½ inches. The wire is wound in the resultant slot. The detailed construction of the above described form is given in Fig. 2. The side pieces, as shown in the detail sketch, should be provided with three slots equally spaced around the circumference. The depth of these slots should not be less than ¼ inch. Each disc is provided with a hole drilled through the center. The discs with the bakelite rings are assembled and clamped together by passing a machine screw of sufficient length through the assembly and tightening with a nut. The discs can be made of any stiff material, preferably bakelite ⅛ or 3-16 inch thick. When the form has been assembled, the slots of the side pieces should be aligned and a length of strong linen thread placed in each slot across the surface of the bakelite rings. The tie strings are used to hold the winding in place and shape after the side pieces have been removed and until the coil is doped.

Six coils are wound, each with 200 turns of number 32 DSC or DCC wire. When wound each string or thread is tied around the winding, at which time the side pieces may be removed. No excessive care of winding the wire in the slot is necessary. The more the scramble, the better, as this will result in a coil of lower distributed capacity. When all the slot wound coils have been made and the side pieces have been removed, the constructor will have six coils with a bakelite core. These coils are now soaked in thin celluloid cement, allowed to stand until the cement begins to set, at which

(*Continued on page 372*)



An Elco 26-foot cabin cruiser of the type being used for the RADIO NEWS Floating Laboratory

*By* W. Thomson Lees
*Managing Editor*

# *Radio News* FLOATING LABORATORY

## *Promoting Entertainment, Navigation Aids and Communication by Radio for the Pleasure-Boat Owner*

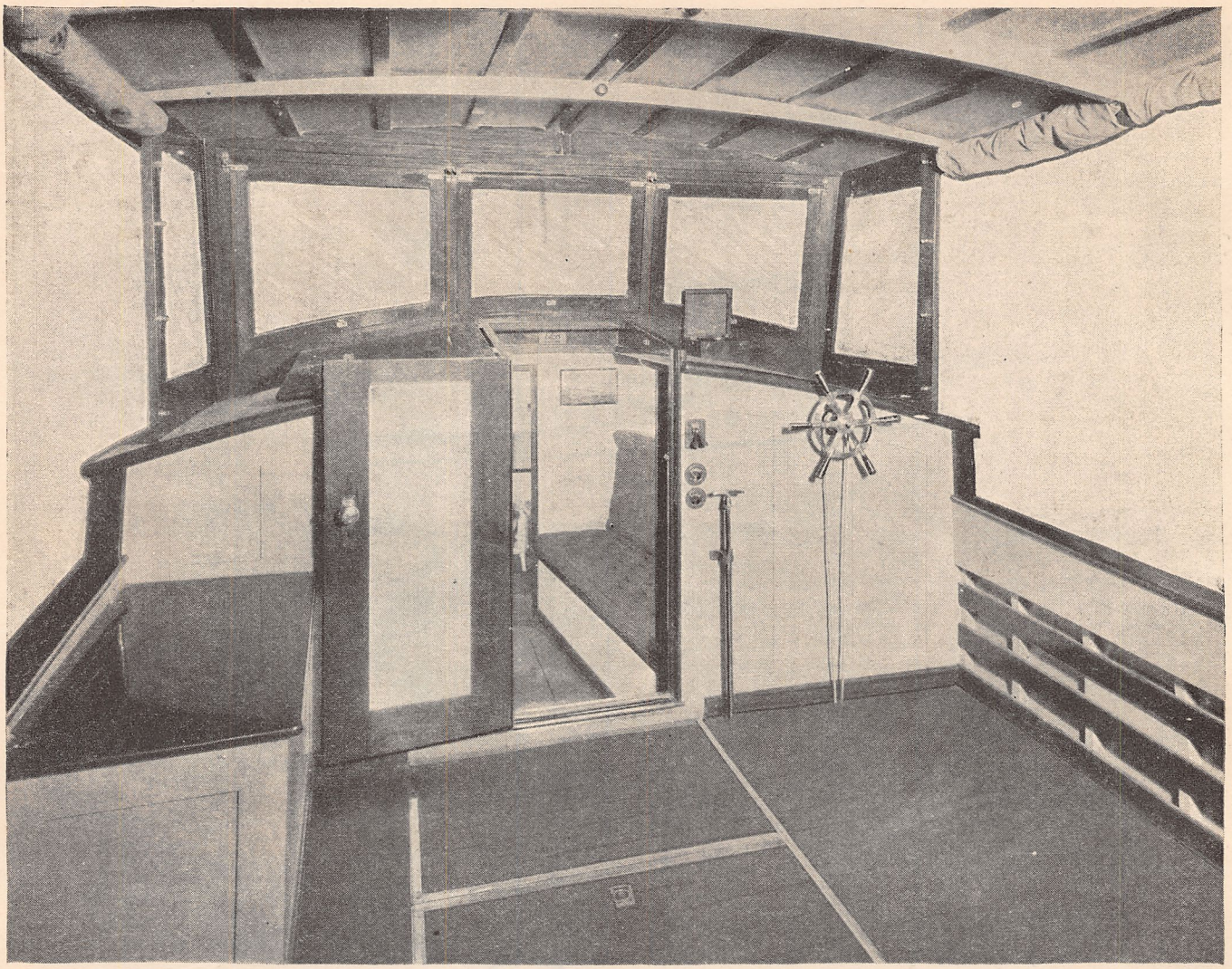
**BY the time these pages are in print the experimental work of the technical staff will be well under way, looking toward the development of—first, a receiver, and later on a transmitter—which will afford to the small boat owner all that he has a right to look for from radio. This means not merely entertainment, but weather reports, time signals, direction finding; in short, *real* radio service.**

**In our November issue we will present a complete account of this work up to the time of going to press.**

IN the case of worthwhile radio ideas, no less than in golf, the important thing is the "follow through." Last month, we had Mr. Lloyd Jaquet present (RADIO NEWS, September, 1929, page 212) the question "Why Not Get the Utmost from Radio on Your Pleasure Boat?" Well—why not?—was the question that kept humming in the heads of the editorial staff. Since everybody we asked seemed to think the answer worth finding, we decided to go after it.

In the first place, there are thousands of pleasure boats plying the waters of these United States, serving as vacation-outing headquarters for their owners. These boats range from small launches to medium-sized and big yachts; but probably the greatest number of them lie within the sizes from about 25 ft. to 50 ft. of the small cruiser type, if we eliminate the ones that are used only for *getting* somewhere, rather than for *being* somewhere.

It is perfectly true that some of the larger sizes of these boats are (in a manner of speaking) "equipped with radio." Not one of them, as a matter of fact, is really equipped with a radio installation that enables its owner to get even a fraction of what radio can give him in the way of (1) safety, (2) aid to navigation, (3) time and weather information and (4) entertainment. Why not?—because,



**Looking forward from the stern of the cockpit. The engine being located under the hatch (in the middle foreground) puts the source of ignition interference practically amidships. It is obviously impossible to locate a receiver far enough away so that distance alone will eliminate this interference**

as yet, there simply "ain't no such animal."

Note that we said, above, that some of the larger cruisers are furnished with radio equipment. This means, simply, a radio set for entertainment; except in the case of boats more properly classed as yachts, in which case a licensed commercial operator is carried.

What we are interested in, is the owner-operated cruiser, used for week-end trips or even more lengthy cruises. We want to develop a receiver that will be almost as important to the owner of this type of boat as his rudder. It has to be ready to while away the time, when all's well, with really high quality entertainment from broadcasting stations; it has to be capable of serving as a direction-finder; it must reach up to the wave-bands on which marine beacon stations operate; it must reach down to the short wave-bands. (The last-named requirement will be enlarged upon, later on.)

With all this, there are other requirements to be met. First of all, ignition interference must be faced and conquered. Next, the set must be so designed as to defy the ravages of salt water. Last, but decidedly not least, both the receiver and its power supply must keep within rather rigid requirements as to size and weight.

In case this brief summary of the conditions to be met is not enough, a more elaborate outline was contained in our previous issue. However, it is one thing to discuss these requirements in the abstract, and quite another thing to attack them concretely. We have, of course, the RADIO NEWS Laboratory; and we intend to make use of it. But we might develop a theoretically beautiful receiver for small cruisers, in the Lab, only to have it turn out that actual practice on a boat is something else again. Obviously, the proof of the pudding lies in the eating.

As this is written, the writer has just returned from a brief trial trip on the newest extension to our laboratory facilities: a 26 ft. Elco cabin cruiser, put at our disposal for this purpose by the Elco Boat Works, of Bayonne, N. J. As described by the manufacturers, this boat is "the smallest practical cruiser"—which makes her ideal for our purpose; because she offers every handicap of size and space, and the results of our experiments will therefore be applicable to cruisers of all sizes.

The trial trip referred to was merely a short run, out in Newark Bay. By the time these lines are in print, however, we expect to be so familiar with our floating laboratory as to call every plank by its first name. More important, by dint of night work and week-end efforts, we expect to have some interesting practical data to unfold before another month rolls around.

We might mention, parenthetically, that if you don't own a boat, or if you don't know a man who owns one, you're missing something. If you live up North, here, you're missing something from April to October; if you're down below the freezing line (or, rather, down *above* it) you're missing something, the year around. No dust; no crowded roads, no need to follow a concrete ribbon—but we'd better pipe down (note the influence of that trial spin) and stick to our subject.

First, then, we're going to go after the bugaboo of interference from the engine. If you have to shut off your motor every time you want to listen to a good radio program, you can't cruise very far. More important, if you get caught in a fog, you don't want to lose steerage-way every time you try to catch a direction-finding signal.

Once we have interference lashed to the mast (getting nautical, again) the other problems will be taken up piecemeal. Circuit possibilities are, of course, many; arrangement of parts, selection of parts, selection of tubes; all of these, and many more, are variables. In a way, it is like

trying to solve an intricate algebraic equation having a dozen or so unknowns and only two or three known factors. Which is exactly why the only practical approach lies in a method of "cut and try."

The known factors are: that where the small size of the boat precludes locating a receiver far from the engine, interference from the ignition system is inevitable; that a highly efficient antenna system is out of the question; that weight and size of the receiver must be kept down, because of space limitations on board; that A and B power supply must be suited to the conditions involved.

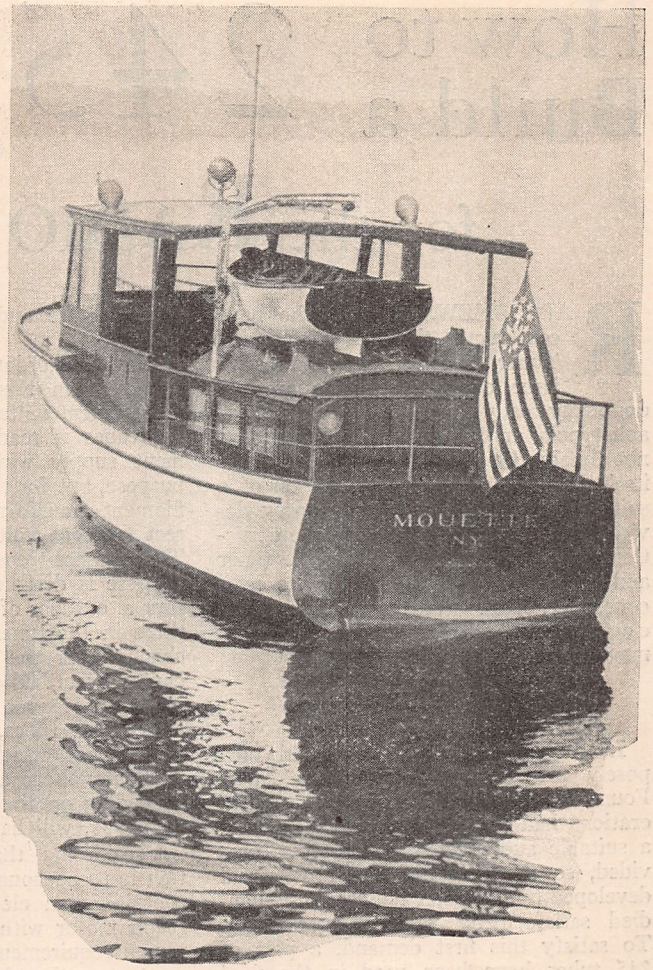
Oh, yes; there is one additional known factor which we forgot to mention: the name of the boat. If we find time, we'll hold appropriate christening ceremonies; if not, she will have to be content. At any rate, she will bear the dignified title RADIO NEWS FLOATING LABORATORY.

The illustrations on these pages give a fair idea of what our floating Lab. looks like. While not pictures of the boat itself, they are views of one of her sister ships, as like as two peas in a pod. The cabin has sleeping accommodations for four (not that we expect to find much time for sleep, during the coming month!) and the cockpit is almost as large as the average nightclub dance floor.

Powered with a 27 h.p. engine, this cruiser makes about ten miles per hour—no challenge to the Bremen, but plenty fast enough to keep going. As will be seen in the illustration taken from the rear of the cockpit, looking forward into the cabin, there is a flush deck hatch immediately aft of the cabin doorway. Under this hatch is the engine, with its electric starter, as well as the storage battery which operates both the starting and lighting systems.

Under that hatch, therefore, is the source of our first major problem: ignition interference. On a fifty-footer it is possible to get a radio set far enough away from the engine to minimize such artificial static; on a twenty-six footer, with the engine almost amidships, that won't work. Whether it will be a case of only special spark plugs and partial shielding, or whether more elaborate methods will be required, will not take very long to determine.

There isn't the least doubt that the Floating Laboratory's cockpit is plenty large enough to permit putting there a most elaborate console type radio set with built-in dynamic speaker. Nor is there any doubt of what would happen to console and set, after the spray from a few whitecaps had played around with them. Nor is there any 110 volt a. c. floating around the water these days. No—the a. c. receiver is definitely out.



**The *Mouette*, famous honeymoon cruiser of Col. Lindbergh and his bride. It is boats of this type, ranging from 25 to 50-foot in length, that have found the widest popularity, and it is for this class of boat that all-around radio service is as yet unavailable**

We are, however, going to take a variety of battery-operated receivers aboard, for comparative tests. And these, incidentally, will give us a line on the efficiency of signal pick-up, as compared with the ordinary home location.

It is obviously impractical to do any amount of actual constructional work on board. That, of course, will have to be done at our base laboratory. If it were not for that—and the comparatively insignificant details of editorial desk work—we might be tempted to forsake the crowded city and embark on an extended cruise. But, being fully alive to the importance of radio—*real* radio—in such a venture, we'd much rather wait until we have developed the receiver for the job.

Too many people measure radio solely by the standard of broadcast entertainment. They know only vaguely, if at all, that there are such things as radio beacons, weather reports, storm warnings, time signals. If it were merely a case of designing a "salt-air proof" receiver in more-than-usually compact form, so that a boat owner could bring in a jazz program or a concert to while away the time, the whole proposition on which we have embarked would be hard to justify.

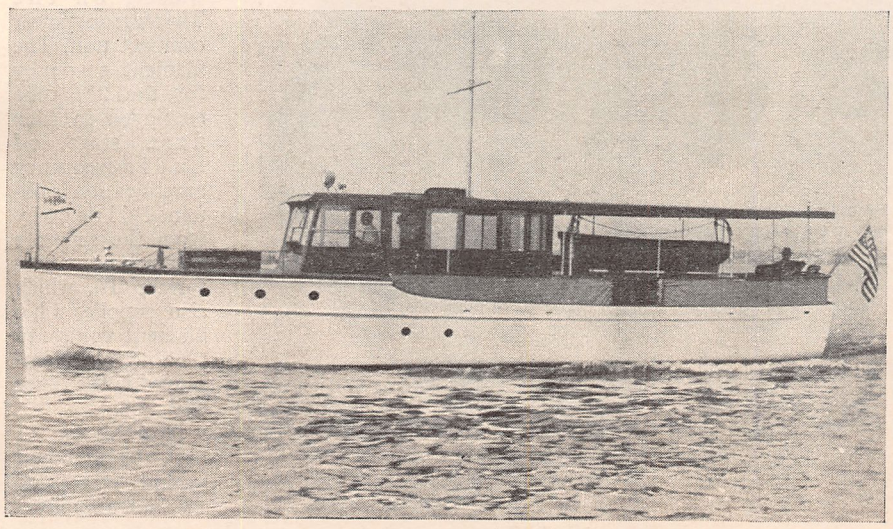
At the same time, until boat owners learn how radio can serve them, there would be scant interest in a specially-designed receiver which ignored the broadcast entertainment feature. And, with the other more difficult requirements we have mapped out, it is comparatively simple to include good broadcast reception.

But, as we said earlier in this article, the proof of the pudding lies in the eating. We want you to know what we are doing and planning, but your real interest lies in the concrete results of our work, and not at all in long-winded discussions of how we are going about getting these results.

When this issue of RADIO NEWS reaches you, we will already be seriously and intensively at work—three men in a boat.

In the next issue, we confidently expect to have some worthwhile reports to make. Until then—RADIO NEWS FLOATING LABORATORY, signing off.

**A 50-foot cabin cruiser. Many boats of this size are equipped with radio, but usually only for entertainment purposes**



# How to Build a 245 AMPLIFIER for the RADIO NEWS *Foundation*

RADIO NEWS readers who have constructed the R-N Foundation Tuner described in last month's issue of this magazine are undoubtedly ready to add to it some acceptable type of amplifier; that is, if they have not already done so. This article concerns itself primarily with the description of a suitable amplifier and power supply device, and secondarily with the instructions governing the installation of a tuner and amplifier power supply device in a console cabinet, which also houses an electrically-operated phonograph with magnetic pick-up.

### *General Considerations*

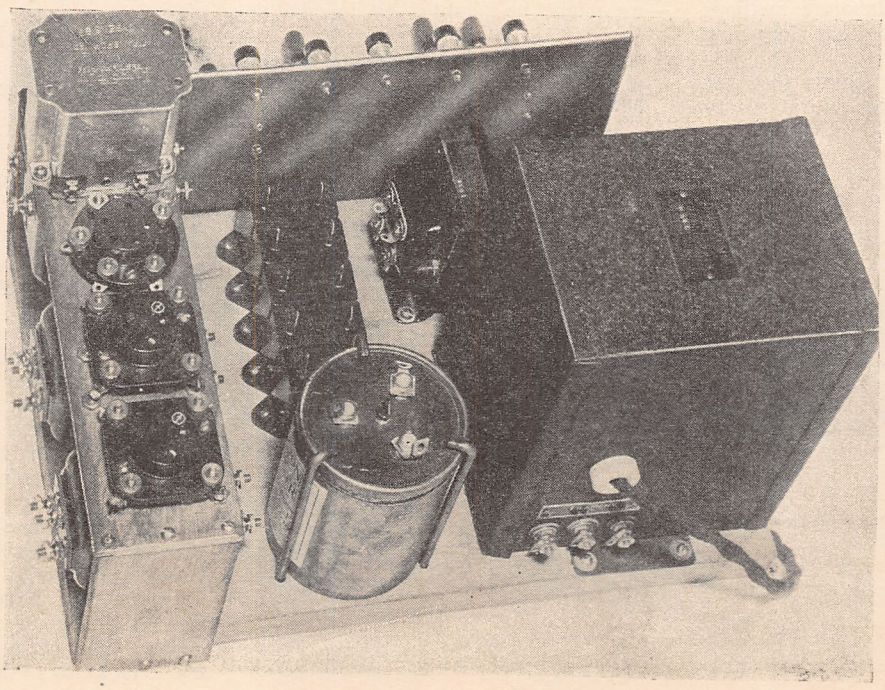
In designing this unit intended purposely for use with the RADIO NEWS Foundation Tuner Unit, several considerations had to be kept in mind. First, a suitable audio channel had to be provided, so that the high level of signal developed by the tuner unit could be handled satisfactorily without overloading. To satisfy this first demand, a pair of 245 tubes have been used in the final or power audio amplifier stage. It is preceded by a stage of audio amplification employing the 227 tube. Reference to the circuit diagram Fig. 1, will show the connections for the entire audio channel. Secondly, the device had to supply not only an audio channel for the tuner unit but also the "B" supply for the plates of the various audio amplifier tubes and also for the plates of the tubes employed in the tuner unit. Thirdly, it had to supply the a. c. filament voltage to the tubes in the audio amplifier and tuner units.

In the Thordarson power transformer employed in this power supply device, the filament voltage for the audio amplifier tubes is readily obtained by a filament supply winding provided for the purpose, but for the tuner unit a separate filament transformer, supplying the correct filament voltage, must be obtained. The filament transformer selected for this purpose is designed to supply current to four a. c. tubes of the 227 or 224 variety, three in the tuner and one in the audio channel. If the amplifier-power supply device described here is used with any other tuner unit employing more than three a. c. tubes, then another type of transformer which supplies the correct filament voltage at the correct amperage, depending on the number of a. c. tubes employed, will have to be used.

Considering that the entire installation is to be housed in a console cabinet containing an electrically driven phonograph motor with magnetic pick-up, the fourth requirement that this unit had to meet, was the ability to change readily from the radio tuner unit to the phonograph pick-up, when desired. As will be seen from the circuit diagram, Fig. 1, a number of switches have been employed to make this possible. In Fig. 2, the position and location in the circuit of these switches, is shown. The double-pole double-throw jack switch, SJ, is used to connect the power amplifier to either the RADIO NEWS Foundation Tuner Unit or any other suitable tuner device, when in one position and to the phonograph pick-up when in the other position. Control of the filament supply of the tuner unit is independent of this switch and must be operated separately when the radio receiver is to be turned on or off. Similarly when the phonograph is to be turned on, then the line switch in the phonograph motor cord which plugs into the 110 volt a. c. supply, must be turned on to start the turntable motor. It will be also noted that there is a pendant switch to control the 110 volt a. c. supply to the audio amplifier-power supply line transformer.

### *The Audio Amplifier*

In all, four transformer units are employed in the audio channel. T1 is the input transformer which couples the plate of the detector tube of the tuner unit to the first amplifier tube. This first stage, which employs a 227 tube, inputs directly into an intermediate stage push-pull transformer. This, in turn, connects to the grids of the two 245 power amplifier tubes and then from the plates of these tubes to the primary of the output transformer. The secondary of the output transformer connects directly into the voice coil of any suitable type of dynamic speaker or to the existing types of approved magnetic speakers. The fourth transformer employed, T4, is a phonograph-coupling transformer and is used to couple the phonograph pick-up to the primary of the first stage audio transformer, T1. By its use, the impedance relations between the magnetic pick-up and the input of the transformer T1 are satisfied.



An over-all view of the 245 power-amplifier power supply device. To the extreme left is the audio channel mounted on and under the shelf. In the center is the filter condenser and by-pass condensers. To the right is the Thordarson power compact, while to the rear is the voltage divider panel with output binding posts

The correct filament voltage for the pair of 245 tubes is obtained directly from a winding on the Thordarson power compact unit. The filament supply for the 227 tube employed in the first stage of audio-frequency amplification is obtained directly from the separate filament transformer T6, which also supplies the filament voltage to the tubes employed in the tuner unit.

Grid biasing of both the first and second stages of audio amplifica-

# POWER SUPPLY DEVICE

## Tuner

By John B. Brennan, Jr.
*Technical Editor*

tion is obtained by means of resistors, placed in the circuits so that a sufficient voltage drop, equal to the required grid bias voltage, is obtained. In Fig. 1 resistor R6 supplies the necessary voltage drop to furnish the grid bias for the first audio amplifier tube, while the resistor R7 provides the voltage drop necessary to supply the grid bias for the two 245 tubes.

### *The Power Supply Device*

In this installation a simple, accepted type of power supply unit is employed. It makes use of a power transformer, delivering at its secondary 300 volts either side of the mid-tap; this secondary voltage is rectified by a full-wave rectifier tube V4. From there on, the filter unit, consisting of two filter chokes and an electrolytic condenser bank of three sections, filters out the d. c. ripple so that a pure d. c. is supplied to the voltage divider. The voltage divider consisting of a number of separate wire wound resistor units is provided with several tapped outlets so that not only are the plate voltages to the tubes in the amplifier channel supplied but also the plate voltages to tubes in the tuner unit provided.

### *Construction*

On a 1 inch board, 9 inches wide by 13½ inches long are mounted the various parts which go to make up the entire power supply and audio channel device. Reference to the parts layout, Fig. 4, will show the placement of these various units. The entire audio unit with phonograph transformer is located at the extreme right end of the baseboard. Phonograph transformer T4 and the three sockets for the three audio tubes are mounted on a shelf which is supported off the baseboard by two end pieces. The details for the construction of these end pieces are shown in Fig. 5. Underslung from the bottom of this shelf are mounted the three transformers; the input transformer to the first audio stage, the intermediate transformer connecting the first audio stage to the push-pull power tubes and the output transformer. Details showing the construction of this shelf will be found in the accompanying photograph and sketches.

In the extreme upper left-hand corner of the baseboard is located the Thordarson power transformer, T5. Directly to its right, between it and the shelf containing the audio channel, is located the three-section Mershon electrolytic condenser unit C2, while to the front of this condenser is mounted the five filter condensers which shunt the various sections of the voltage divider. To the front of the baseboard at the extreme left is located the socket which takes the rectifier tube, V4; to its right is located the filament transformer, T6. Along the front edge of the baseboard is mounted a bakelite panel which holds the various voltage divider resistors and also the binding posts for connecting the B plus power and a.

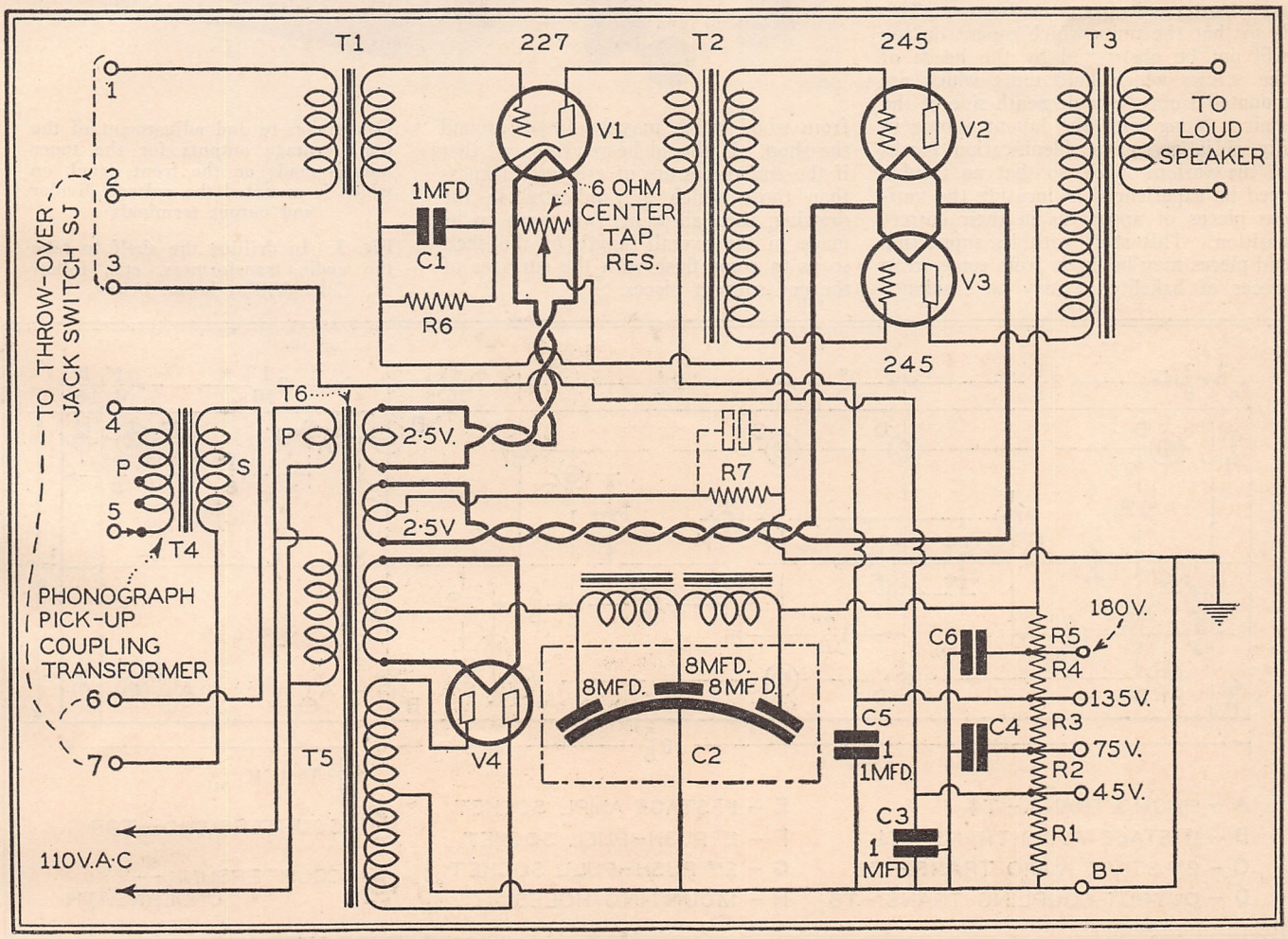



**Fig. 1. The 245's schematic circuit. Along the top is shown the audio channel, while below is the power supply circuit details**

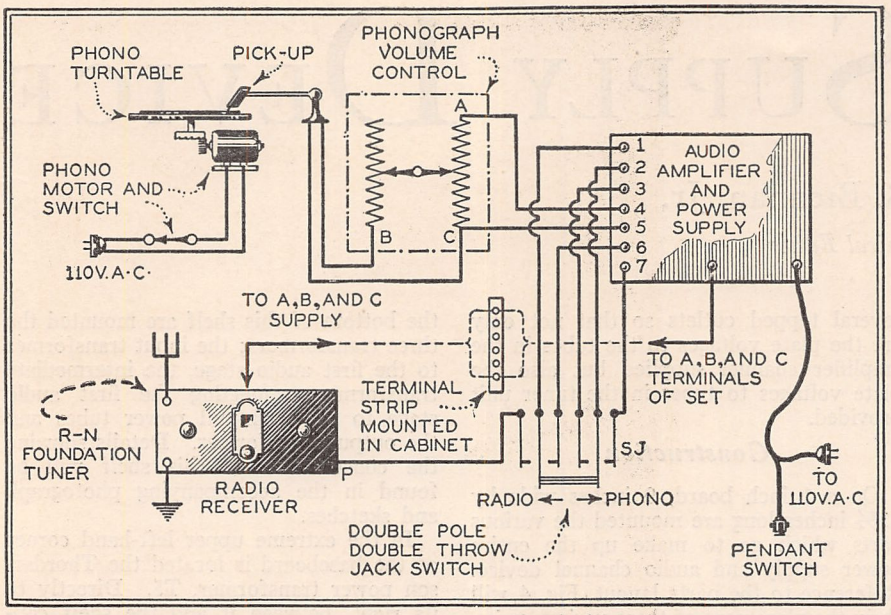


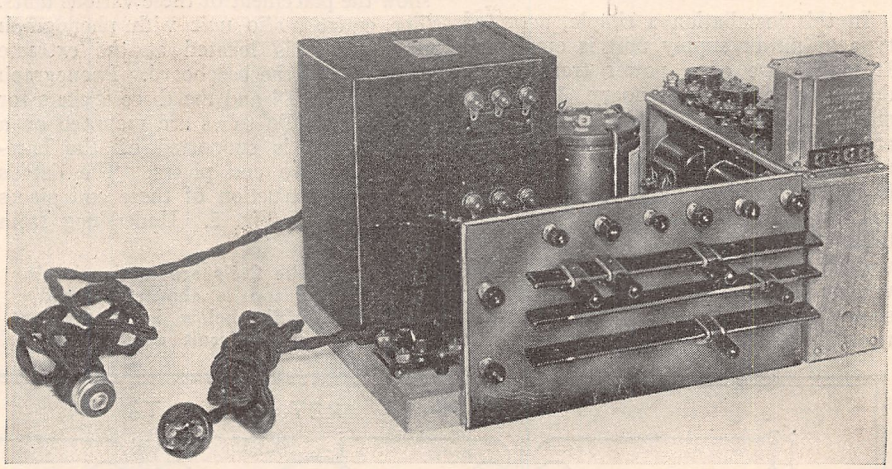

**Fig. 2. To connect the amplifier-power supply device to a phonograph pickup and radio tuner the above diagram will prove helpful**

c. filament leads of the tuner unit to the power supply device.

In laying out the position of the holes for mounting the socket and transformer units on the shelf, it will be necessary to follow quite closely the layout which is given in Fig. 3. It will be noted in this layout of the shelf, that some of the holes are countersunk on top while some are countersunk from the bottom. This is so that the units which mount on top will not be obstructed by the heads of the screws which hold units which are mounted from the underneath side of the shelf. Along with the layout shown in Fig. 3 is given the idenification marks of the various holes, so that no trouble need be experienced in locating the various pieces of apparatus in their correct position. This shelf with its supporting end pieces may be made from some scrap pieces of bakelite or may be fashioned from wood which may be found around the shop. It should be remembered that if the end pieces are of greater thickness than those which are indicated in the drawing, then allowance will have to be made in the overall length of the shelf so as to come flush with the surfaces of the end support pieces.

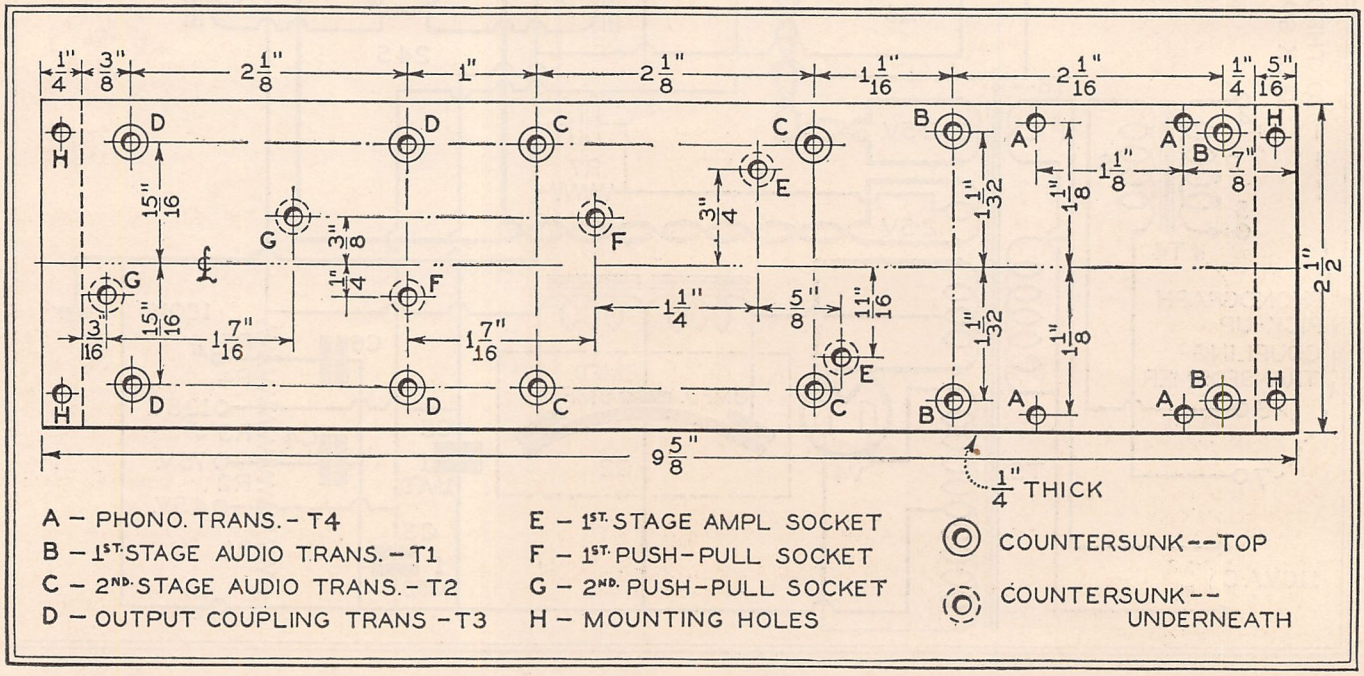
The Mershon condenser is not supplied with any means for fastening it to the baseboard, so therefore it will be necessary to provide a suitable way of mounting it in place, permanently. In the laboratory we made use of several pieces of round brass rod bent at right angles at one end and threaded at the other. These pieces serve to clamp the condenser unit down to the baseboard. The threaded ends pass through holes in the baseboard and are fastened with nuts which are located in a counterbored recess drilled into the underside of the baseboard.

The heavier units, such as the power transformer, T5, and the filament transformer, T6, should be firmly fastened to the base by means of one-inch wood screws which should be provided with suitable washers. The use of smaller screws will do undoubtedly as a temporary measure, but if the unit is to be moved around considerably, then it will be found that quite likely the weight of these transformers will cause the screws



**Connection to and adjustment of the plate voltage outputs for the tuner unit is made on the front panel, on which is mounted the voltage divider and output terminals**

**Fig. 3. In drilling the shelf to take the audio transformers, etc., follow the drilling layout below.**


1/4" 3/8" 2 1/8" 1" 2 1/8" 1 1/16" 2 1/16" 1/4" 5/16"
2 1/2"
9 5/8"
1/4" THICK
A – PHONO. TRANS. – T4
B – 1ST STAGE AUDIO TRANS. – T1
C – 2ND STAGE AUDIO TRANS. – T2
D – OUTPUT COUPLING TRANS – T3
E – 1ST STAGE AMPL SOCKET
F – 1ST PUSH-PULL SOCKET
G – 2ND PUSH-PULL SOCKET
H – MOUNTING HOLES
COUNTERSUNK--TOP
COUNTERSUNK--UNDERNEATH

to pull out from their holes and make remounting of them necessary.

In the kit of Carter voltage divider resistors, which is obtained under the catalog designation of No. 2314, three resistors are provided, one of which is a plain resistor without slider tap, the second a two section resistor with two slider taps and a third having three slider taps. In the way in which this kit is used here, it is necessary, before mounting the resistors on the panel, to take one of the sliders off the second unit and place it on the first. Also, it is necessary to join together by means of a wire connection, the two sections of the second resistor strip. Arrangement of these resistors is shown in Fig. 6.

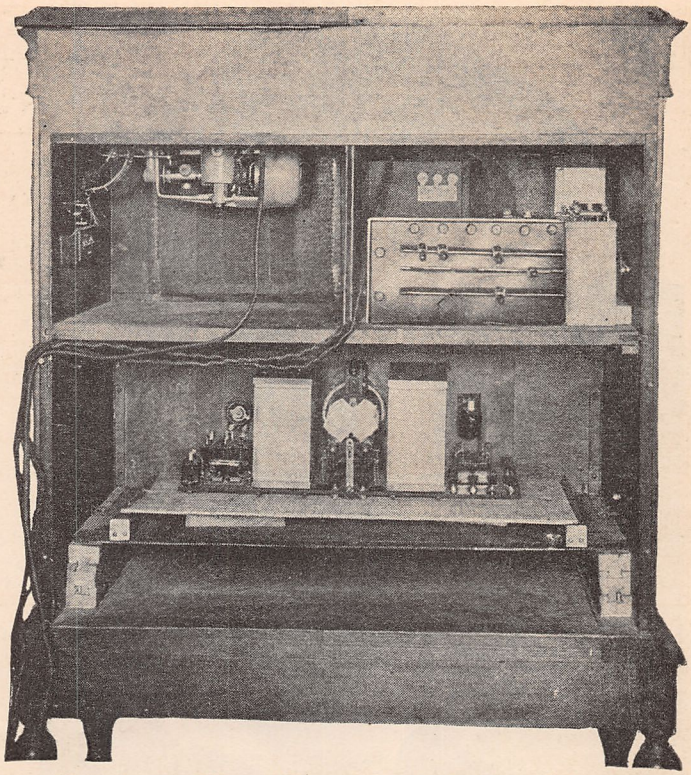
The resistors may be mounted on any scrap piece of panel (which will undoubtedly be found in the junk box) by means of small brass angle pieces readily obtainable in a hardware or 5 and 10 cent store.

### *Wiring*

In wiring this amplifier and power supply device there is one thing that should be kept in mind quite firmly. That is, that all of the wires which terminate at the filament posts of the various tubes should be twisted so as to minimize the possibility of the production of hum in the loud speaker. Moreover, since the current consumed by the tubes is quite high, it will be necessary to use heavier wire than is usually employed in the wiring of d. c. receivers. Wherever possible leads should be bunched together and formed into a suitable cable. In every case, the connections should be soldered so as to preclude the possibility of connections becoming loose once the unit is put into operation.

### *Operation*

The amplifier-power supply device described here has been designed primarily to fit the space which is available in the console cabinet used. By the same token the layout of the various switches and the volume control regulator, has been made with a view to accessibility in this particular type of console cabinet and it is likely that where another type of cabinet is employed, some other arrangement will be found necessary. However, the general layout and especially the connections of the various units, one to the other, will remain the same. It is well, for instance, to have the line switch which controls the 110 volt supply to the phonograph motor mounted as near to the turntable as possible. The double-pole double-throw switch, SJ, may be mounted either on the tuner unit panel or in the "well" containing the turntable.



**Here is the 245 amplifier supply device housed in the console, in which is located the phonograph and R. N. Foundation tuner unit**

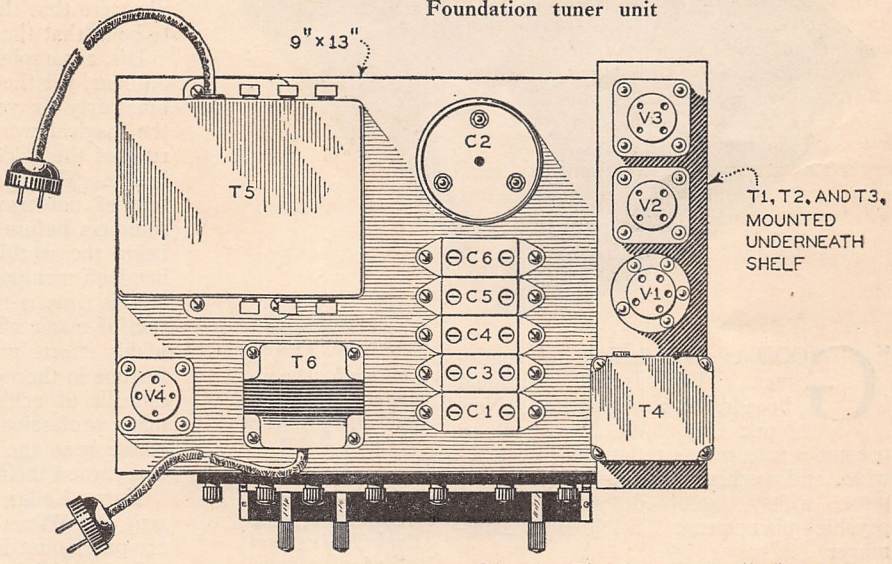
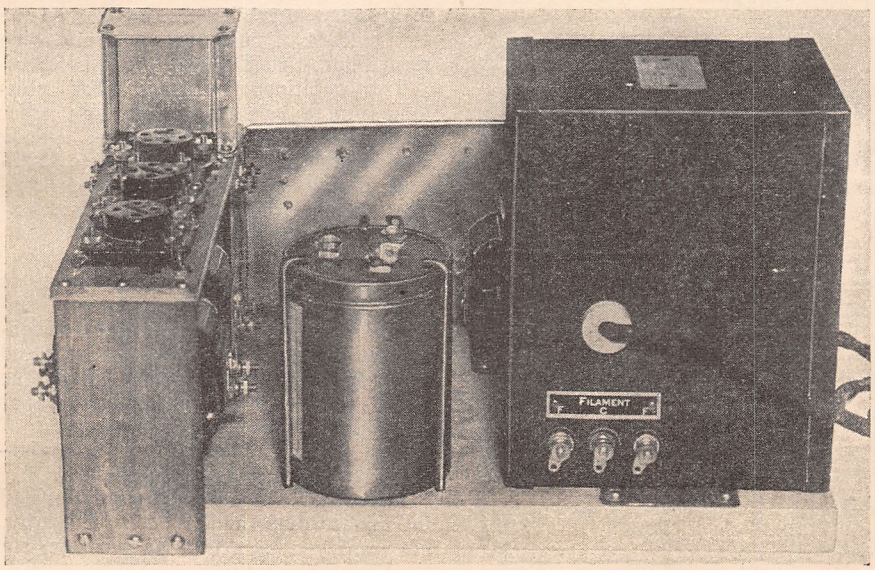



**Fig. 4. The layout of all the parts which are to be mounted at the base and shelf in the above sketch. Compare it with the several phonographs accompanying**




**A rear view of the power unit. Note how the filter condenser is fastened to the base**

The volume control, of course, should be mounted in the same compartment which houses the turntable so that ready control of the volume from the pick-up can be obtained. Actual control of the line voltage to both the audio amplifier-power supply device and tuner unit is, of course, controlled by the pendant switch which should be connected to a cord sufficient in length to be readily accessible from the front of the console cabinet. If it is desired, another switch which connects in the filament supply to the radio tuner unit may be employed so as to control the filament supply to the tuner independently of any of the other switches. Thus, when the phonograph is in operation, it will be possible to turn

(*Continued on page* 381)

# *The* Personality the Ghost

*By* Frances Rockefeller King

Courtesy National Broadcasting Company

**Joseph Dunninger; drawn from life by Gaspano Ricca**

"GOOD evening, ladies and gentlemen. This is the National Broadcasting Company, New York City. We are about to present a man whose reputation is world-wide, and perhaps the best known and most widely accepted authority on psychic phenomena. . . . Joseph Dunninger. . . ."

Undoubtedly, a large proportion of the radio audience received not only this announcement, but the "Ghost Hour" which it introduced, with more than a grain of skepticism. Dunninger, seated at the microphone in the New York studio of the National Broadcasting Company, projected three thoughts over the N. B. C. network. Listeners-in were invited to try to receive this projection, and to send in their replies. The items projected by Dunninger were as follows: the name of a president (which proved to be Lincoln); a number composed of three digits (3-7-9); and a small drawing or diagram (which consisted of a small house, four windows, one door, a triangular roof, and chimney).

Over two thousand letters were sent in to the National Broadcasting Company from all parts of the country. Of these, over fifty-five per cent. had some part of the thoughts correct.

Whether we are prepared to accept Dunninger's theory or not, we must at least admit that this large percentage of nearly correct vibrations received proves mental telepathy a possibility, and when we stop to think that over forty per cent. got the name of Lincoln right, and that over five per cent. received the entire array of thoughts correctly, the outcome of these demonstrations via radio furnishes food for thought.

Dunninger has done many things for which there seems to be no ready explanation. About a year ago, his car was stolen, and when found, was discovered wrapped around an elevated post. When the theft was reported to police headquarters, the captain laughingly requested that the owner demonstrate his ability as a mindreader by locating the car, and the thief. In this remarkable test Dunninger succeeded, and inasmuch as the knave is now serving a term in the penitentiary, having been proved guilty of this offense, it goes to illustrate that this was not a press stunt, as many believed it to be at that time.

His accomplishments and unique ability have astounded millions, yet the most marvelous feature of it all is that he is but thirty-six years of age. Never before in the history of the magical world has a man been able to climb to the top rung of the ladder of successful endeavor at so early a period in life. The late Harry Houdini, one of the greatest characters of universal show-world, had passed more than forty summers before he had earned for himself the reputation of being the world's premier mystifier in the exclusive art of handcuff manipulation, of his period. Howard Thurston, who at this time is touring the country with the largest presentation of magic and illusions, did not begin to harvest the fruit of his efforts until rather late in life. To obtain fame and fortune in the world of conjuring seems to be one of the most difficult of achievements known in the field of any of the many professions. The "Greats" of the past were all men in whose head the gray had begun to predominate, before they had earned their position as masters in their chosen fields.

Harry Kellar, Alexander Herrmann, Robert Hellar, Anderson, the Wizard of the North, and other such names that are paramount in the pages of magical history, may authentically be added to this list. Yet no man in the entire history of mystery entertainment, has earned the vast amount of publicity, and world-wide recognition, that Dunninger can boast of.

This ambitious young artist has entertained more celebrities than any other entertainer in his particular line. Among these might be mentioned the late President Theodore Roosevelt, the late President Warren G. Harding, ex-President William Howard Taft, ex-President Calvin Coolidge, and H. R. H. the Prince of Wales. Many gala society functions have programmed the appearance of Dunninger, and the smartest parties throughout the United States have been arranged with the exclusive purpose of giving the friends of the hosts an opportunity of witnessing the unique demonstration of thought transference and Indian conjuring, in which Dunninger specializes.

Dunninger has always been interested in mindreading and mental telepathy. He frankly admits that he possesses no

**Below — Clipping from *The New York Telegram* telling of a typical Dunninger exploit**

THE NEW YORK TELEG

## *Joe Dunninger Shatters Peace of Ghost Seance*

**Friend of Harry Houdini Offers $21,000 to Slater, Hailed by Spiritualist General Assembly as "Greatest Medium of All," for Answers to Two Questions in Sealed Envelope.**

John Slater, who in the expressed belief of the General Assembly of Spiritualists, is the greatest medium of them all, had the spirits well under control last night. At the Pennsylvania Hotel they were answering the questions of any who might come along and pay his $1, his $1.50 or his $2.

But Slater, who, as related by the same assembly, left home at the tender age of 20 because his family thought him crazy when he "heard voices," reckoned without an old enemy. Not Satan, whom love will overcome, but Joe Dunninger.

**Houdini's Friend Pipes Up.**

Joe, who used to be associated with Harry Houdini in exposing mediums, went to the meeting. He paid $1.50 and got a good seat. So did four of his friends. They listened while Slater delivered spirit messages to young and old, black and white.

Then Joe, who prefers to be called "just Dunninger," spoke up. His voice wasn't particularly gentle and he was waving his arms. The thirty-third annual state assembly sat up

the Hanover Central Bank. He waved it aloft, and he waved the envelopes, both with big red wax seals.

**Medium Loses Calm.**

It was then that the spirits almost deserted the gathering of 3,000—there was standing room only in the grand ballroom. Physical action seemed forthcoming. Slater's cohorts moved on Dunninger. Dunninger's friends stood up.

Slater, who had just been preaching the advantages of calmness and love, seemed to lose both for a moment. Dunninger left protesting. He offered to duplicate any "spiritual" feat performed by Slater.

"It's not the game, though," he protested. "Any one who takes money to talk to spirits for you and—" Dunninger was spluttering.

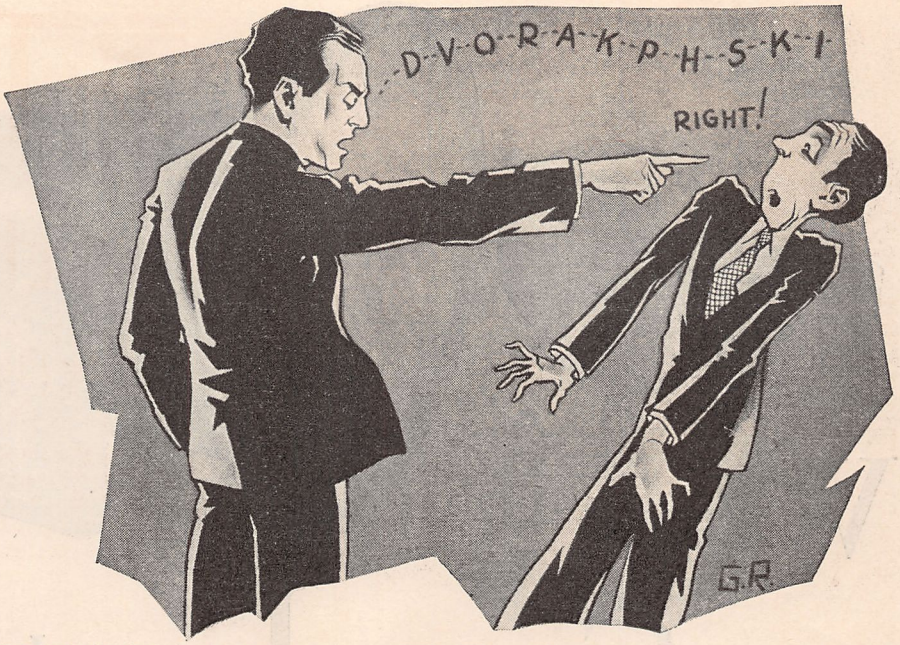
"He's a vulture," he finished with heat.

**Will Continue Tonight.**

Slater, surrounded by admiring cohorts, had regained love and peace, however. He will continue tonight.

"And, my dear people, there will

# Behind Hour




Courtesy National Broadcasting Company

**Artist Ricca's impressions of a mind reading demonstration**

supernatural powers, and that all of the weird things he accomplishes are but the outcome of constant study and practice. Yet, to the layman who has viewed his remarkable demonstrations, this is hard to conceive. In his school days, he could call the answer to a mathematical problem without following the usual essential routine of working out an example. When his 'phone would ring, he was often said to be able to tell who was on the other end of the wire, before lifting the receiver. Yet in spite of the fact that this odd freakish mental condition afforded him amusement, he sought to delve further into the depths of kindred mystic subjects.

He studied the arts of the East Indian wonderworker, as well as the methods of the European magicians, and, having been a great admirer of the late Harry Houdini, he was not to be outdone in this branch of the profession, and also studied the methods of self-liberation. Dunninger has among his hundreds of scrap books one in particular that he fondly treasures. This contains one hundred and sixty-five letters which have been given, after a successful challenge release, and signed by chiefs of police and prison officials in various parts of the globe.

Dunninger would enter the warden's office and defy him and his aides to place him in a cell from which he could not liberate himself. He would be stripped of his clothing, thoroughly examined, and after being securely shackled and handcuffed, would soon find himself locked behind the bars of one of those dismal cages of confinement. As a rule, it would take this young wizard but two or three minutes before he would again re-enter the warden's office, fully dressed, and holding the opened shackles in his hand. Escaping from packing boxes, water filled tanks, straitjackets, etc., was also part of Dunninger's routine, and although he soon discarded this work from his repertoire, he still possesses one of the largest collections of restraint implements and handcuffs in the world. The pillories, antique irons, and special devices used as far back as the Spanish Inquisition are included in his collection that numbers into the thousands.

His knowledge of the magicians' art has also been attained by practical experience, judging from the fact that at the present time he has over three hundred illusions in his storehouse, many of which have been used by famous magicians, past and present.

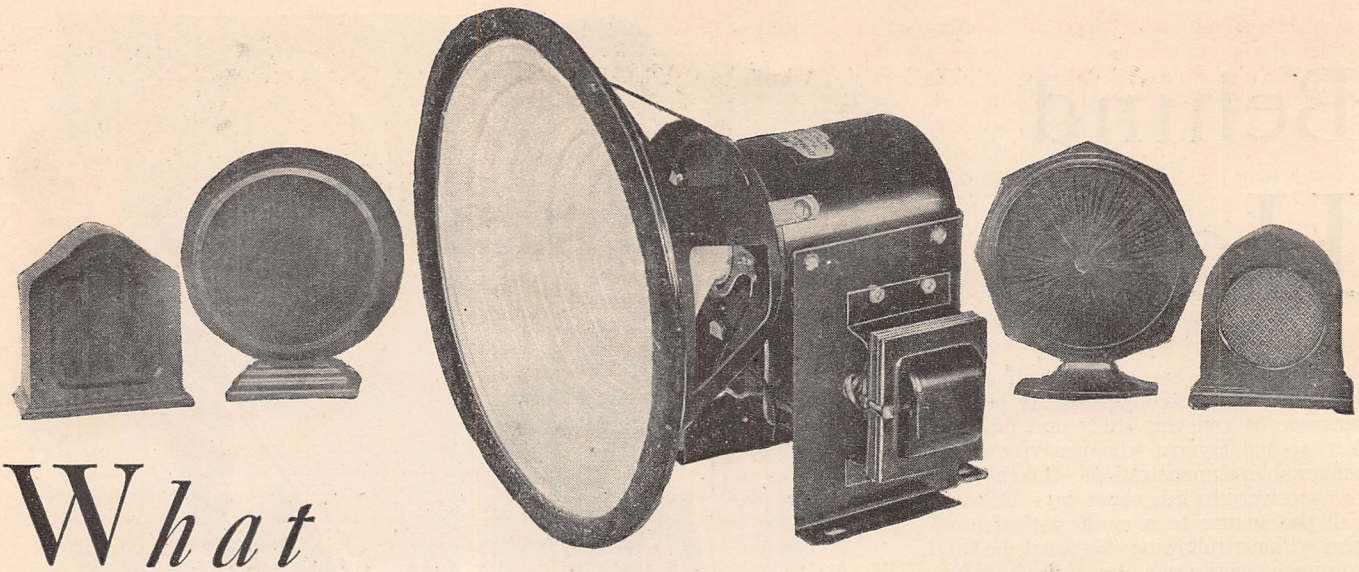
In this collection is one particular effect that is known the world over. This is called the Automaton Psycho. Many years ago this illusion was purchased by the late Harry Kellar, from Maskelyne and Devant in England. It changed hands, and became the property of Charles Carter, Howard Thurston, back again to Kellar, and then to the late Harry Houdini.

Dunninger offered Houdini $1,500 for this effect, but was smilingly refused; yet when the latter died, his friend was agreeably surprised to find that Houdini had made provision so that Psycho would be passed on to him.

Psycho consists of a small Arabian figure, which rests upon a glass cylinder.

(*Continued on page* 358)

**Dunninger with Howard Thurston, the magician. At 36 the former's accomplishments already rival those of his older predecessors**



# What Is A GOOD Loud Speaker?

## A Discussion of the General Types of Reproducers With Special Treatment of the Dynamic

*By* James Martin

THE loud speaker is but one link in the chain that connects the broadcasting station with the listener in his home. It is no more—or less—important than any of the other links. In the radio chain between the artist's voice and our own ears there are microphones, transformers, wire lines, the ether, a loud speaker, batteries and tubes; defects in any one of them can ruin a program. Considering all the possibilities for distortion, the excellent quality that a good radio installation can supply is really remarkable. It is indeed fortunate that, unlike a woman, electrical apparatus is not fickle. Once put in good condition it will with ordinary care remain in such condition for a long time (referring of course, to the electrical apparatus and not the woman.)

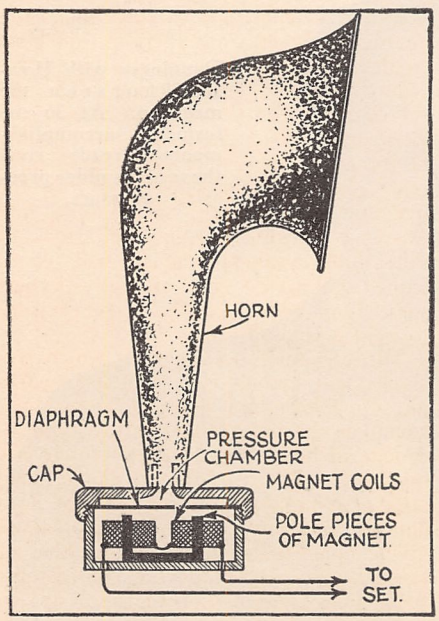



Fig. 1. The first types of loud speakers were nothing more or less than a phone unit with horn attached to ampilfy the sound

Most of the larger broadcasting stations transmit excellent quality signals. There is no reason why every experimenter with a good tuner and a good audio amplifier should not be able to listen to excellent reproduction—provided of course that he has equipped his set with a good loud speaker—one that is capable of reproducing most of the audio frequencies with uniformity and without any serious distortion. Of all the links in our chain it is probable that, generally speaking, the loud speaker is the weakest. For this, if for no other reason, the greatest of care must be exercised in its selection. Because the loud speaker is so important we have devoted this article to a discussion of it, pointing out what requirements it must meet and something of how to judge loud speakers with the hope that it will perhaps help the home constructor and experimenter to obtain maximum enjoyment from his hobby—radio.

In the first place, what is a loud speaker? It is a machine. And its function is to take the electrical energy which it obtains from the radio receiver and convert this energy into sound. This it does through the medium of the diaphragm which, vibrating in the air in accordance with the variations in the electric currents passing through the coils, produces variations in air pressure. When these variations in pressure strike our ears they cause small membranes in our ears to move and we hear a sound.

### *The Perfect Loud Speaker*

What would be the characteristics of a perfect loud speaker? In the first place, a perfect loud speaker would reproduce all the frequencies over the entire audio-frequency band which extends from say 15 cycles up to about 12,000 to 14,000 cycles. It would reproduce all these fre-

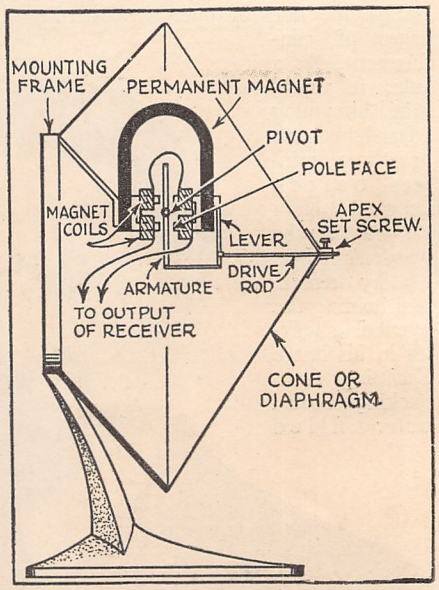
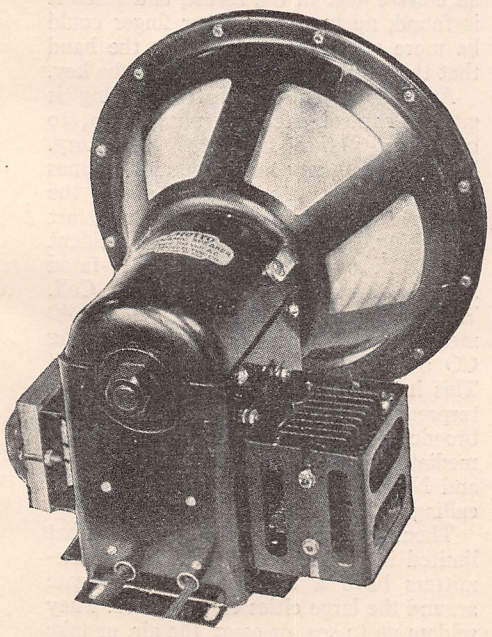



Fig. 2. Cone loud speakers employ in general a driving mechanism similar to that shown here. The entire cone acts as a diaphragm

quencies without discrimination, in other words a response curve of its performance would be "flat" over the entire band. The perfect loud speaker would introduce no new frequencies; that is, if supplied with a pure 60-cycle current it would produce a pure 60-cycle note and not a complicated tone consisting of some 60 cycles and also some of the harmonics of 60 cycles. It would be capable of handling the maximum desired volume without distortion due to overloading or rattling. It would be efficient, converting all or nearly all of the electrical energy supplied to it into sound. It would have a very long useful life and be not in the least affected by dampness or other atmospheric conditions. Does anyone know of a loud speaker that meets all of these requirements? I don't.

Fortunately the loud speaker we use doesn't have to be absolutely perfect to produce very good results and make listening to radio an enjoyable pastime. The problem is how far the practical loud speaker can depart from the ideal and still be satisfactory. The range of audio frequencies extends, as previously indicated, from about 15 to 14,000 cycles, but the problem is to decide how many of the low frequencies and how many of the high frequencies can be eliminated before serious distortion results. Conpetent authorities feel that essentially perfect reproduction can be obtained in the frequency band between 30 and 10,000 cycles, the elimination of all frequencies above and below these limits causing no noticeable change in quality. Further it has been found that cutting the frequency band from 10,000 down to 6,000 or 7,000 cycles produces but a very slight change in quality—a change that can only be detected by a direct comparison between the original and the reproduction.

As a result of many practical tests it has also been found that a variation of three to one in the response characteristic is practically negligible and the variations of five to one are not especially important.



A dynamic speaker, showing coupling transformer and dry rectifier

Practical tests have also shown that a distortion of five percent is also not noticeable. A practical loud speaker can be quite inefficient, for the efficiency does not effect the quality and simply necessitates that we must supply the loud speaker with more power for a given volume of sound. Present day loud speakers are characterized by very low efficiencies. Probably the best of loud speakers are one or two percent efficient; that is for very 100 units of electrical energy supplied to them they only produce 2 units of sound. If loud speakers could be made ten times as efficient as at present probably we could all throw away our power tubes!

In summary therefore we can say that a loud speaker, to be "practically" perfect should reproduce the band of audio frequencies between 30 and 6,000 cycles, that the amplitude distortion should not be greater than about three to one, that the harmonic distortion should not be

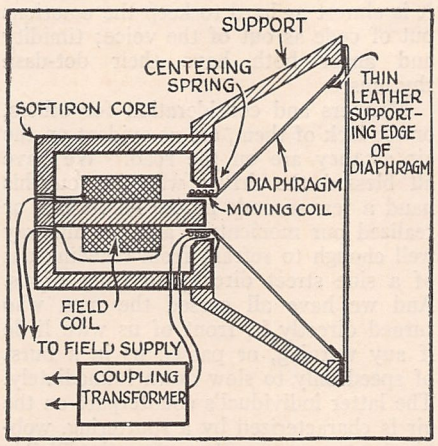


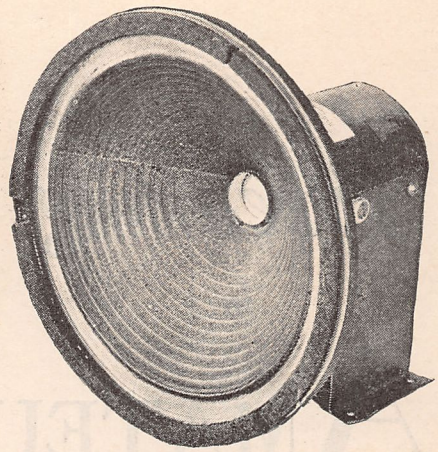

Fig. 3. Herewith is shown the general arrangement of the various parts of a dynamic speaker. Compare it with that shown below

greater than about five per cent and that, although high efficiencies are desirable, quite low values of efficiency are not especially disadvantageous since sufficient power to make up for the low efficiency can easily be obtained from ordinary power tubes.

### *Several Types of Speakers Now in General Use*

Loud speakers have been made using a large variety of principles but most of them have proven impractical for one reason or another. All loud speakers in use today (with the exception of the condenser loud speaker) depend for their operation on magnetic forces. The three types of loud speakers now in general use are the horns, Fig. 1, cones using balanced armatures, Fig. 2, and dynamic loud speakers, Fig. 3, which are cones driven by a moving coil. The two former types, *i. e.* horns and ordinary cones, have definite limitations. Horns, unless they are of the exponential type and very large are definitely limited in frequency response. A newcomer in the loud speaker field is the condenser speaker of which more will be heard of in a following article.

Probably the outstanding example of a good balanced armature type loud speaker



To give the cone of this dynamic a degree of rigidity, it is serrated, as shown in the battery-operated dynamic above

is the Western Electric cones, types 540 and 560. These loud speakers, especially the 540 and similar cones made by other manufacturers, were exceedingly popular and have experienced competition only lately by the introduction of the dynamic type loud speaker. The balanced armature type of loud speaker drive is arranged as indicated in Fig. 2. It consists of a permanent magnet, M, with four pole faces arranged adjacent to the armature. The armature is balanced between the pole pieces and around the armature is wound the coil which is connected to the radio set. The audio-frequency currents from the output of the set, passing through the coil, caused it to move in the space between the pole pieces. In so moving it of course carried the diaphragm with it and the movements of the diaphragm produce a movement of an air column thus causing the sound. Well designed balanced armature type loud speakers are capable of giving quite excellent results although they have several quite definite defects, among which are magnetic saturation, limited movement, resonance in the armature and driving pin, varying impedance characteristic, etc., and these are sufficient to definitely limit the results obtainable from this type of loud speaker. The better cones of the last two or three years were probably as good as could possibly be obtained consistent with reasonable cost. In a certain sense therefore the dynamic loud speaker was forced into existence because of the limitations of other loud speakers—the art had to advance and in the case of loud speakers some fundamental change was necessary to permit this advance.

The dynamic speaker, with which this article will mainly concern itself, works on principles quite different from those found in the balanced armature type although in both cases magnetic forces are involved. Because the dynamic loud speaker is rapidly replacing both the horn and the ordinary cone, being capable of giving much better results than either of these types, we will devote considerable space to an examination of the design of dynamic loud speakers. After all a loud speaker, even the best, is simply a number of pieces of metal, paper, fibre and wire and it is useful to know how these

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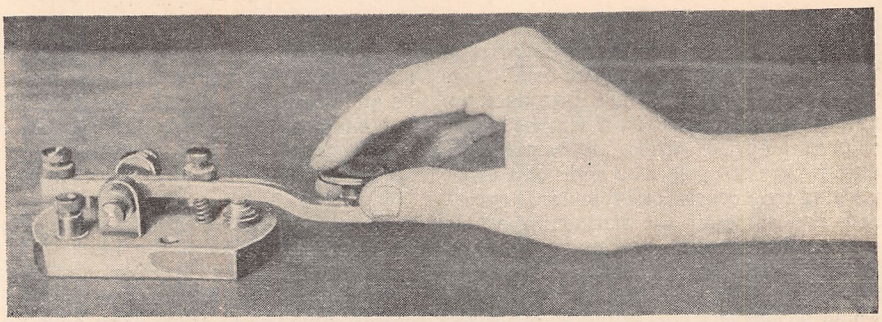


# Breaking into AMATEUR TRANSMITTING

*By* Lieut. William H. Wenstrom, U. S. A.

LAST month we traced at some length the absorbing story of Amateur Radio; we now consider some of the practical problems which confront an entrant into the transmitting fraternity. First of all, let us forget any lingering hostility which we may feel towards code—the dot and dash signals of radio telegraph stations. Once fairly learned, code is not at all the stupid, meaningless collection of symbols that it appears to outsiders. Ruling out machine and "bug" sending, an unbelievable amount of personality trickles through the sending of an individual, however measured he may strive to make it. We can easily classify experts and dubs—can even recognize quickly an operator with whom we have talked before. No two humans are exactly alike, and tricks of spacing and tempo mark an individual as surely as his manner of parting his hair. Strange as it may seem, it is almost as hard to keep the emotions out of code as out of the voice; timidity and anger both have their dot-dash rhythms.

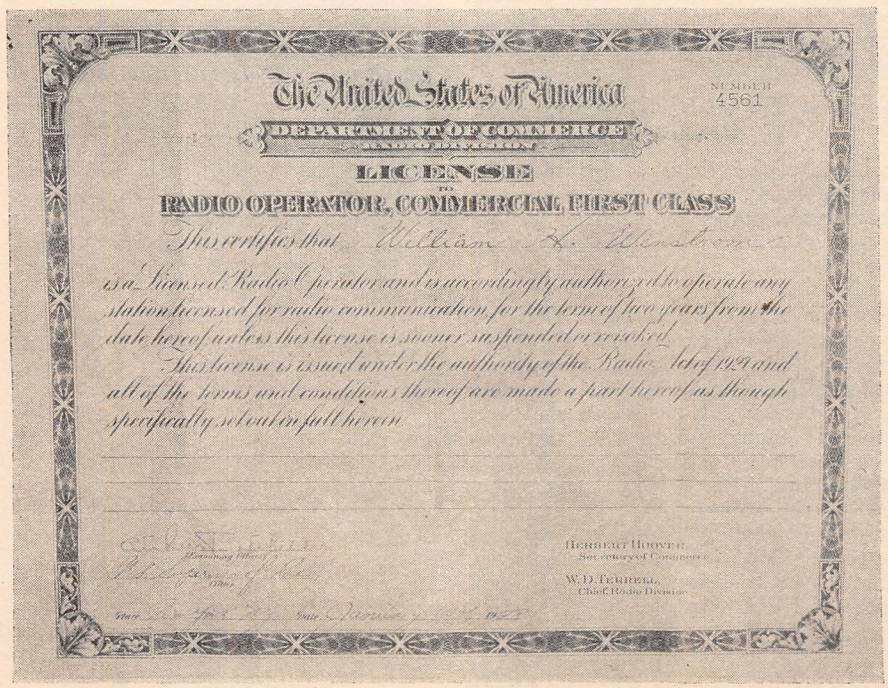
Manners and consideration for others, or the lack of them, are as evident on the air as they are on the road. We have all blessed the driver who put out his hand a few seconds before he turned, or realized our momentum along a highway well enough to refrain from crawling out of a side street directly in front of us. And we have all cursed the man who turned directly in front of us with little if any warning, or passed us in a burst of speed only to slow down immediately. The latter individual's counterpart on the air is characterized by a sputtering, wobbly note, too-rapid and unintelligible sending, and scarely anything to say except "hows mi sigs? rpt my sig strength—pse send card—cul gb." When we come back with "hr msg air transport emergency," he greets us with a profound silence only to be broken by a sputtering "cq" for somebody else. But this type is fortunately a very small minority—else all cars would be wrecked and all transmitters gathering cobwebs. By means of abbreviations two good operators can talk in code almost as fast as they could by telephone. The system is a sort of home-made shorthand wherein unnecessary letters, particularly vowels, are omitted. Weather is wx, press is px, repeat is rpt, thanks is tnx or tks, your is ur, very is vy, please is pse; and so on, ad libitum.

Another distinctive pleasure of transmitting is that two-way communication requires far more skill than receiving. When skill entails work, distasteful to many of us, this statement may seem rather paradoxical; nevertheless, it is a fact, amply proved by observation. The devotees of chess would scarely consider checkers; a hunting horseman has no taste for ambling through the park on a tame nag; good sailormen would be bored to death on a motorboat. The transmitting operator has not only his receiver to think of; the transmitter must be turned on and adjusted for frequency, output, efficiency and steadiness. The wily distant station must be sought among the channels like an elusive deer in the forest, and when it is found, no hunter's trigger finger could be more smoothly certain than the hand that throws the switches and taps the key.

Another advantage of transmitting is greater control over the phenomena, to borrow a phrase from the laboratory. Reception is likely to degenerate at times into a sort of watchful waiting, but the owner of a transmitter can always start something. A well-remembered incident at W2CX occurred during the ill-fated Atlantic flight of Nungesser and Coli. W2CX hopped into the well filled 40 meter conversational puddle with a long CQ and "Any news of Atlantic fliers?" This innocent inquiry was apparently interpreted as a statement preceding the broadcast of important news, for immediately half the stations in New York and New England were heard frantically calling W2CX.

Then, too, phone receiving is somewhat limited in its scope, for broadcast transmitters have a tendency to congregate around the large cities of the world. They seldom go to sea, or essay the air, or take themselves off into remote jungles. But the amateur and experimental code sta-

**The Department of Commerce of the U. S. Government issues to all who satisfactorily pass the required tests a license similar to Lieut. Wenstrom's, shown here**


The United States of America

NUMBER 4561

DEPARTMENT OF COMMERCE

LICENSE

TO

RADIO OPERATOR, COMMERCIAL FIRST CLASS

This certifies that William H. Wenstrom

is a Licensed Radio Operator and is accordingly authorized to operate any station licensed for radio communication for the term of two years from the date hereof unless this license is sooner suspended or revoked.

This license is issued under the authority of the Radio Act of 1927 and all of the terms and conditions thereof are made a part hereof as though specifically set out in full herein.

HERBERT HOOVER,
Secretary of Commerce.

W. D. TERRELL,
Chief Radio Division.

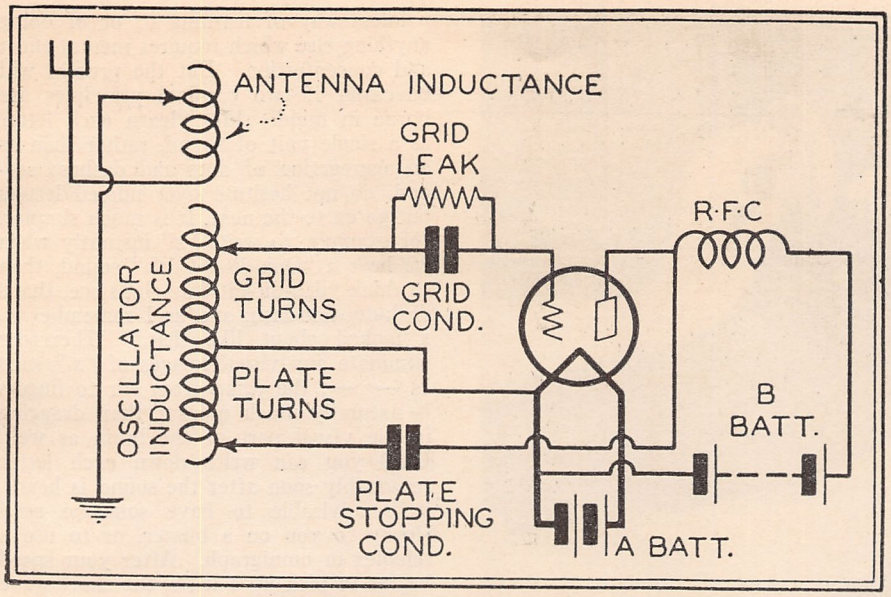



**Fig. 1. One requirement of the Government test is to draw the circuit diagram of the transmitter you intend to use**

tions are everywhere. Another W2CX red letter occasion was an evening chat with a courteous Englishman up in Cameroons, French Equatorial Africa. It consisted mostly of questions from New York and answers from Cameroons. "Are you on the coast or up in the jungle? — about 100 miles from coast. Is it pretty hot there? — very warm all year round. Are there any lions around there?—lots of game here, both big and small." If the answer had been "there is a big lion looking in the window and roaring now," we would probably have believed it.

Atlantic flights and roaring lions are all very well in their way, but let us get down to business. Several weeks at least before he starts actual transmitting the new operator should have completed the installation of a short wave receiver, both for code practice and for familiarity with the various amateur bands. Just what kind of receiver this is does not particularly matter, so long as it meets certain fundamental requirements. The first of these is ability to go smoothly into and out of oscillation at any frequency within the receiver's range. (A grid biasing potentiometer, as used in the Portable Receiver described in the July issue, is useful here.) Secondly, the amateur band corresponding to any particular coil should be well spread out along the center of the tuning dial. The extreme fulfillment of this requirement is the "traffic tuner" which spreads a single amateur band over the whole dial. Somewhat the same delicacy of tuning with better all around coverage may be gained by connecting a midget condenser (cut down to one stator and one rotor) in parallel with the regular tuning condenser of about 140 m. m. f., as shown in Fig. 1. Another requirement is the ability to change wave-bands quickly, and still another is some form of arm rest for tuning, as shown in the photograph. Distant high frequency stations cannot be snapped in with the casual dial twist that does for broadcast tuning.

Most recent short wave receivers employ a screen-grid radio frequency amplifier tube, and this is satisfactory for rapid two way work (though scarcely necessary with a long outdoor antenna) if no extra tuning controls are added. For searching a band quickly the receiver must be strictly single control (have only one tuned circuit). This does not include the oscillation control, which requires only occasional adjustment.

There are now so many good short wave receivers available that anyone may easily buy or build one. The four commercials — Silver - Marshall, National, Pilot, and Aero—are well designed and dependable. Then there is Samuel Egert's "S-W Four" described in the August issue, of which the detector unit and one audio stage would do very well for amateur work. A general discussion of 1929 amateur receiving requirements appeared in QST for November, 1928. For anyone who wants the utmost simplicity and ease of construction combined with creditable performance, the writer's "Cornet Receiver" described in Radio Broadcast for April, 1928, should prove useful. This set is still in use at W2CX, for nothing in the way of all-around code and phone performance by any newer design has inclined us to discard it.

## *Code Practice*

The greatest bugbear in the way of becoming an operator is undoubtedly mastering the code. There is no absolutely

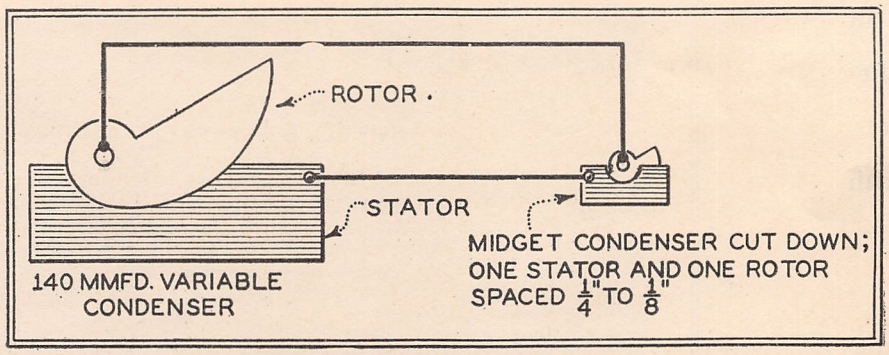
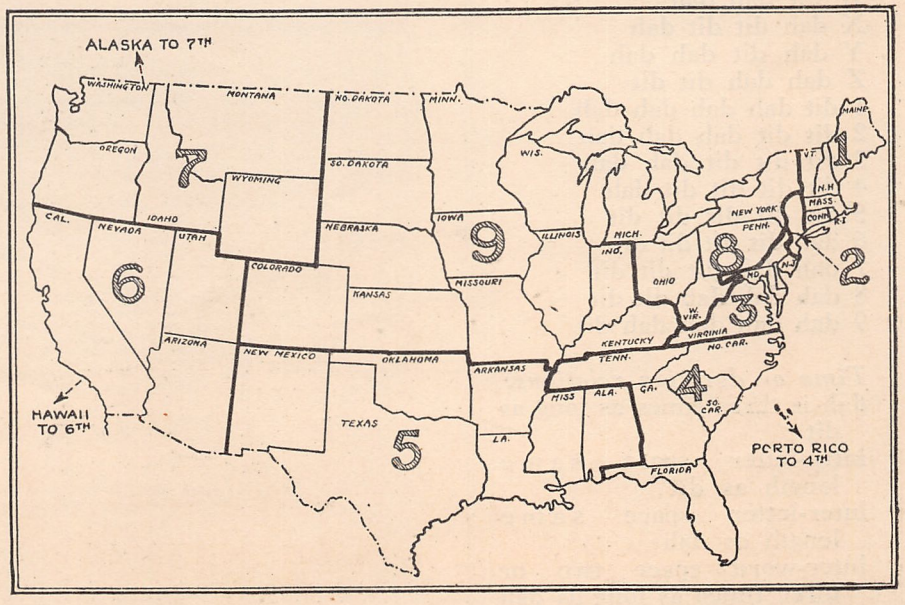
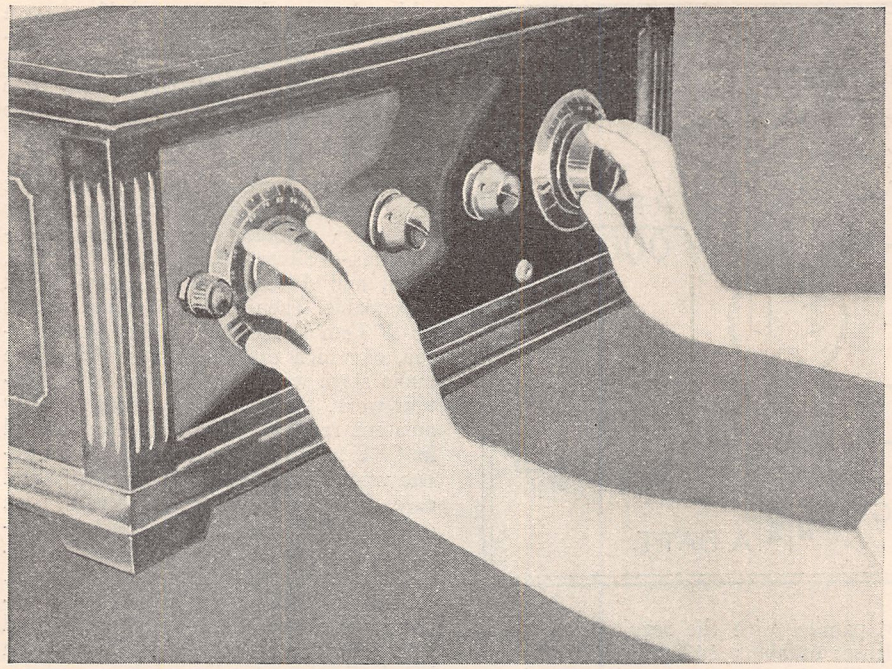



**Fig. 2. To obtain a high degree of fine or vernier tuning action, a small condenser may be shunted across the main tuning capacity**

**Fig. 3. The United States is divided into nine districts, as shown, to facilitate control and regulation of amateur transmitting activities**





A firm, substantial rest for the forearms is an absolute necessity for distance tuning

Your station license, when issued, will authorize you to begin your transmitting career

painless way of learning it, or of doing anything else which requires mental effort and concentration. But the process will be easier if two cardinal principles are borne in mind. First, learn each letter as a single unit of sound, rather than as an aggregation of dots and dashes; second, do not hesitate over missed letters but go on to the next. It is much simpler, for example, to write "x" instantly when we hear a "Dah-dit-dit-dah" sound, than to think "dah-dit-dit-dah—let's see, that's dash-dot-dot-dash, and as I remember it, x looked about like that." Therefore eliminate any visual images of "x," such as —··—; the jump from ear to fingers is naturally much quicker than dragging in the visual part of the brain as well. Until you can write down each letter reasonably soon after the sound is heard, it is advisable to have someone send slowly to you on a buzzer, or to use a teleplex or omnigraph. After your speed begins to pick up a little, the short wave receiver offers a more varied and interesting field for practice. It is usually possible to find in one of the bands an amateur sending at a speed you can copy, and sometimes the highpower commercials are slowed down as low as ten words a minute under poor transmission conditions. Along with reception it is well to practice keying. As shown in the photo-

(*Continued on page* 364)

## THE GENERAL SERVICE CODE

A dit dah
B dah dit dit dit
C dah dit dah dit
E dit
F dit dit dah dit
G dah dah dit
H dit dit dit dit
I dit dit
J dit dah dah dah
K dah dit dah
L dit dah dit dit
M dah dah
N dah dit
O dah dah dah
P dit dah dah dit
Q dah dah dit dah
R dit dah dit
S dit dit dit
T dah
U dit dit dah
V dit dit dit dah
W dit dah dah
X dah dit dit dah
Y dah dit dah dah
Z dah dah dit dit
1 dit dah dah dah dah
2 dit dit dah dah dah
3 dit dit dit dah dah
4 dit dit dit dit dah
5 dit dit dit dit dit
6 dah dit dit dit dit
7 dah dah dit dit dit
8 dah dah dah dit dit
9 dah dah dah dah dit

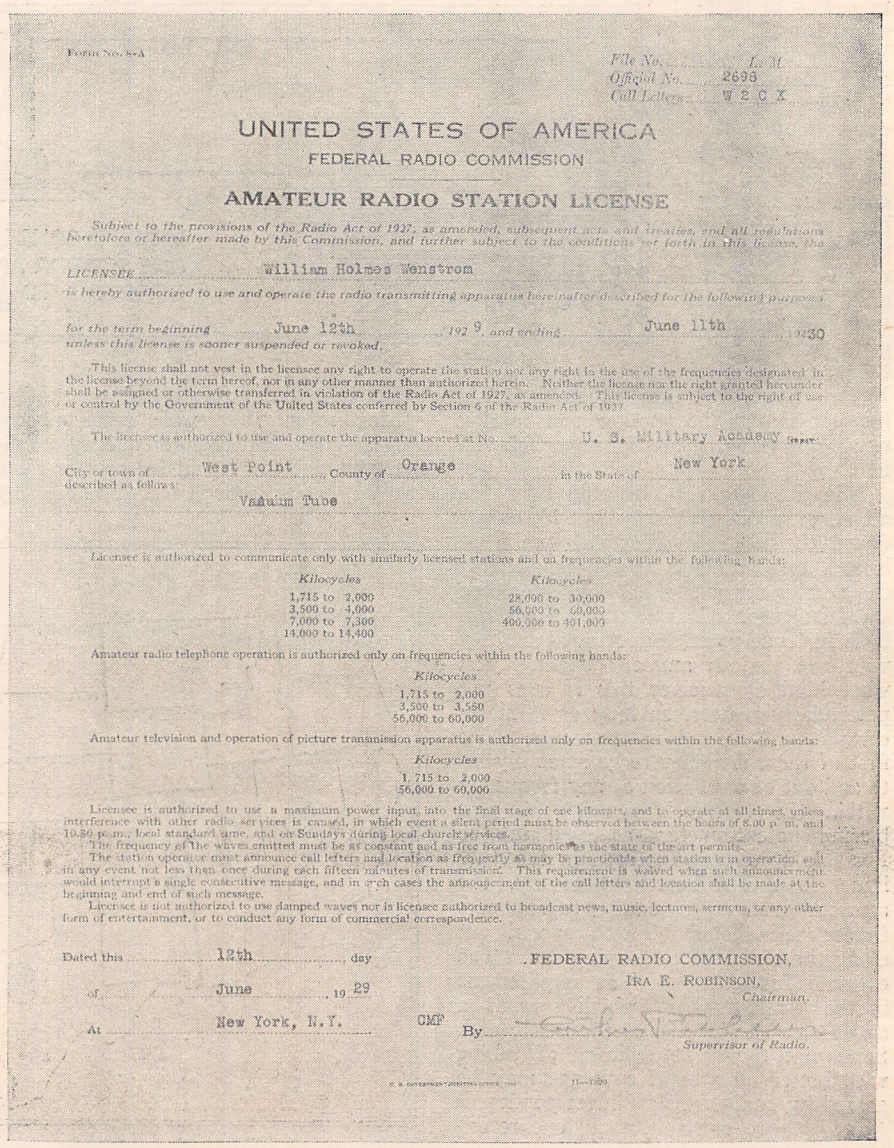
*Time or duration relations:*

dah is three times as long as dit

intra-letter space same length as dit

inter-letter space same length as dah

inter-word space two or three times as long as dah



Form No. 8-A

File No. L. M.
Official No. 2698
Call Letters W 2 C X

UNITED STATES OF AMERICA
FEDERAL RADIO COMMISSION

AMATEUR RADIO STATION LICENSE

*Subject to the provisions of the Radio Act of 1927, as amended, subsequent acts and treaties, and all regulations heretofore or hereafter made by this Commission, and further subject to the conditions set forth in this license, the*

LICENSEE William Holmes Wenstrom

*is hereby authorized to use and operate the radio transmitting apparatus hereinafter described for the following purposes*

*for the term beginning* June 12th *1929 and ending* June 11th *1930*
*unless this license is sooner suspended or revoked.*

This license shall not vest in the licensee any right to operate the station nor any right in the use of the frequencies designated in the license beyond the term hereof, nor in any other manner than authorized herein. Neither the license nor the right granted hereunder shall be assigned or otherwise transferred in violation of the Radio Act of 1927, as amended. This license is subject to the right of use or control by the Government of the United States conferred by Section 6 of the Radio Act of 1927.

The licensee is authorized to use and operate the apparatus located at No. U. S. Military Academy Street
City or town of West Point County of Orange In the State of New York
described as follows:

Vacuum Tube

Licensee is authorized to communicate only with similarly licensed stations and on frequencies within the following bands:

| Kilocycles | Kilocycles |
|---|---|
| 1,715 to 2,000 | 28,000 to 30,000 |
| 3,500 to 4,000 | 56,000 to 60,000 |
| 7,000 to 7,300 | 400,000 to 401,000 |
| 14,000 to 14,400 | |

Amateur radio telephone operation is authorized only on frequencies within the following bands:

| Kilocycles |
|---|
| 1,715 to 2,000 |
| 3,500 to 3,550 |
| 56,000 to 60,000 |

Amateur television and operation of picture transmission apparatus is authorized only on frequencies within the following bands:

| Kilocycles |
|---|
| 1,715 to 2,000 |
| 56,000 to 60,000 |

Licensee is authorized to use a maximum power input into the final stage of one kilowatts and to operate at all times, unless interference with other radio services is caused, in which event a silent period must be observed between the hours of 8.00 p. m. and 10.30 p.m., local standard time, and on Sundays during local church services.

The frequency of the waves emitted must be as constant and as free from harmonics as the state of the art permits.

The station operator must announce call letters and location as frequently as may be practicable when station is in operation, and in any event not less than once during each fifteen minutes of transmission. This requirement is waived when such announcement would interrupt a single consecutive message, and in such cases the announcement of the call letters and location shall be made at the beginning and end of such message.

Licensee is not authorized to use damped waves nor is licensee authorized to broadcast news, music, lectures, sermons, or any other form of entertainment, or to conduct any form of commercial correspondence.

Dated this 12th day of June 19 29
At New York, N.Y. CMP

FEDERAL RADIO COMMISSION,
IRA E. ROBINSON,
*Chairman.*

By
*Supervisor of Radio.*

# The Tube Industry Becomes BIG BUSINESS

*By* William F. Matthews

ALMOST over night the tube-making part of the radio industry has emerged from a state of comparative uncertainty to become one of the most stable and promising divisions of the whole enterprise.

With starting suddeness radio broadcasting swept over the land and set up a constantly growing demand for tubes. With the electric light bulb industry to offer a basis for manufacture, the infant tube industry got away to a flying start. Now catching up with demand, then running ahead of it; beset with innumerable manufacturing difficulties and the pitfalls caused by an impatient public; remedying its faults as it went along and uncovering still more secrets locked in the depths of refinement — these and many other influences presented themselves for the industry to hurdle. From the laboratory in a small bedroom to the mammoth tube manufacturing plants of today with untold millions of capital invested; from nothing at all to sales approaching $150,000,000 annually with many more millions in sight—that, my friends, constitutes the swift growth of the radio tube business, in but a few years.

There are at present more than fifty manufacturers engaged in making radio tubes. The products of the majority of these manufacturers are really high-grade, although those enjoying the best of research facilities and the capital to put refinements into production naturally are in a better position to turn out better products. And yet some of the most notable advances in tube construction and performance have emanated from the laboratories of manufacturers not so favorably situated. Genius follows no prescribed nor dictated path.

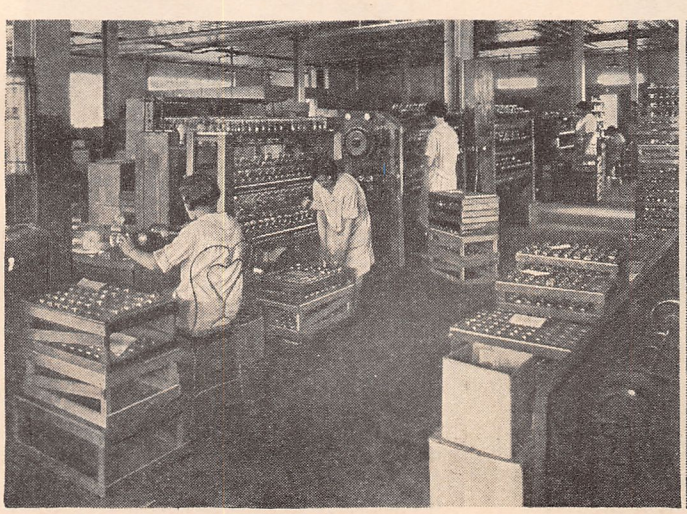
The capitalizations of these tube companies range all the way from a few thousand dollars to many millions. The majority of the companies are closely held, having been financed by a few individuals. Several, however, enjoy listing on various stock exchanges and thus serve as an index of the business. Moreover, a surprisingly large number of the tube companies, both publicly held and otherwise, are making money. The income from tubes constitutes the bulk of the earnings of the Radio Corporation of America, although no definite figures are available. Many of the so-called independents, such as Ceco, Triad, Sonatron, Sylvania, Gold Seal, Marvin, Arcturus, Van Horne and a host of others, derive their sole income from the sale of tubes and many of them are in a flourishing and expanding condition. Conceivably, tube manufacturing may be overdone, and yet it may be several years before retrenchment will set in. That the industry is bound to go through successive corrective stages no one, save possibly an over-enthusiastic manufacturer, will deny; and then he will most likely pay the penalty of his enthusiasm.

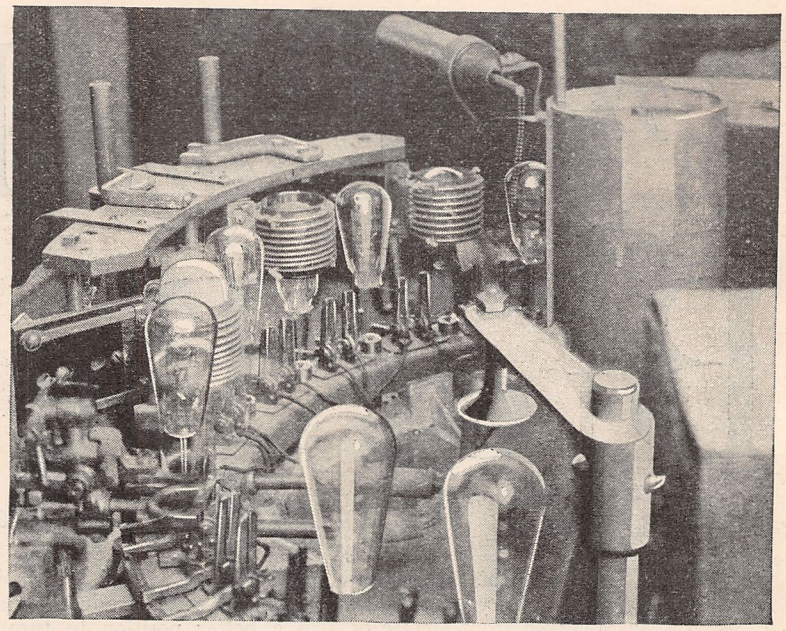
### *Where Is the Saturation Point?*

According to figures compiled by the Department of Commerce, the saturation point in radio is far, far away. It has been estimated that only one-third of the homes throughout the United States possess radio receiving equipment, and throughout the world the percentage is exceptionally small. Add to this the fact that the world never yet has caught up to the mythical saturation point on any product that is good.

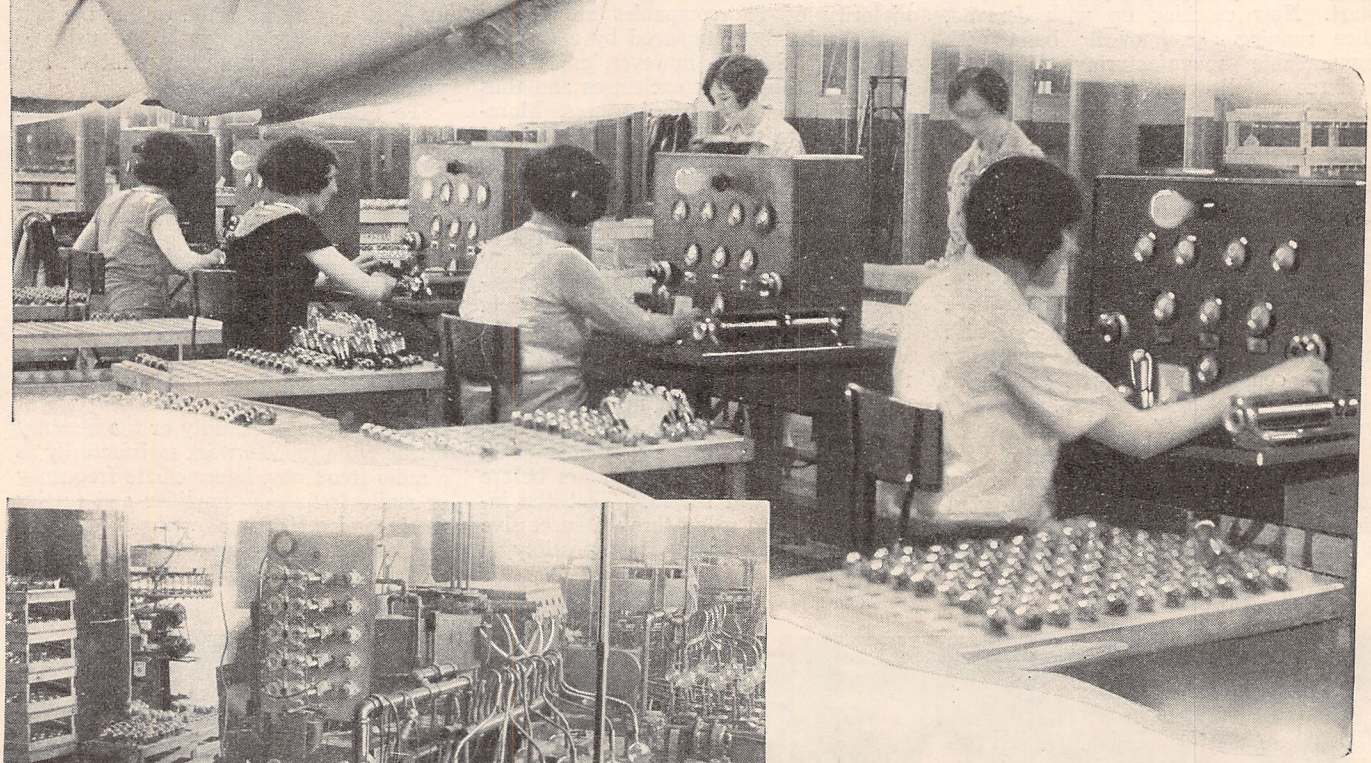
To begin with, we had a radio tube. Now we have radio tubes. In the early days of the radio novelty era, any screech or howl that came through the loud "squeaker" sufficed. Then began the quest for quality coupled with sensitivity. Tubes influenced radio design and quality of condensers, transformers and such like influenced the output of tubes, and the whole was dependent on what the loud speaker was willing or able to interpret. Radio reception was faced with a whole array of handicaps, the principal one of which was the inflexibility or the inability of *the* radio tube to work satisfactorily as a radio frequency, intermediate frequency or audio frequency amplifier and rectify the incoming signals as well. And so the problems of designing suitable tubes for

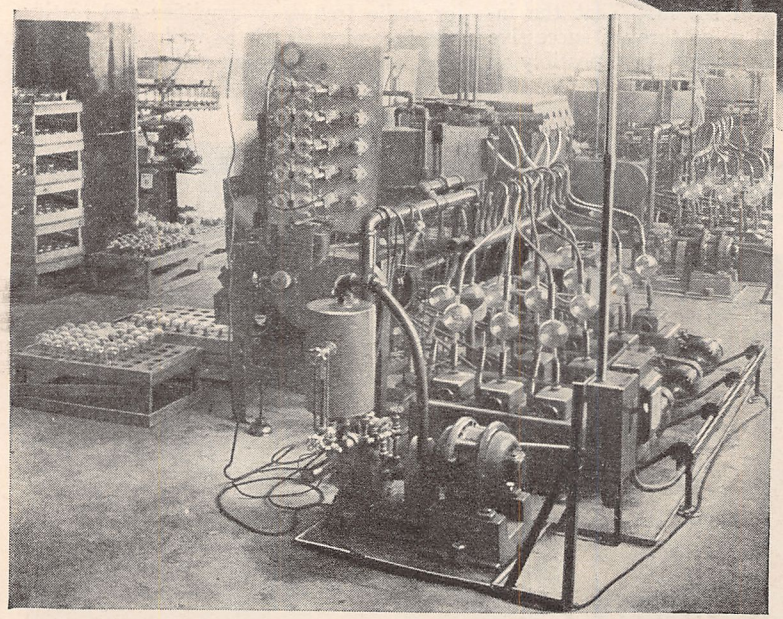
Courtesy Cable Radio Tube Corporation





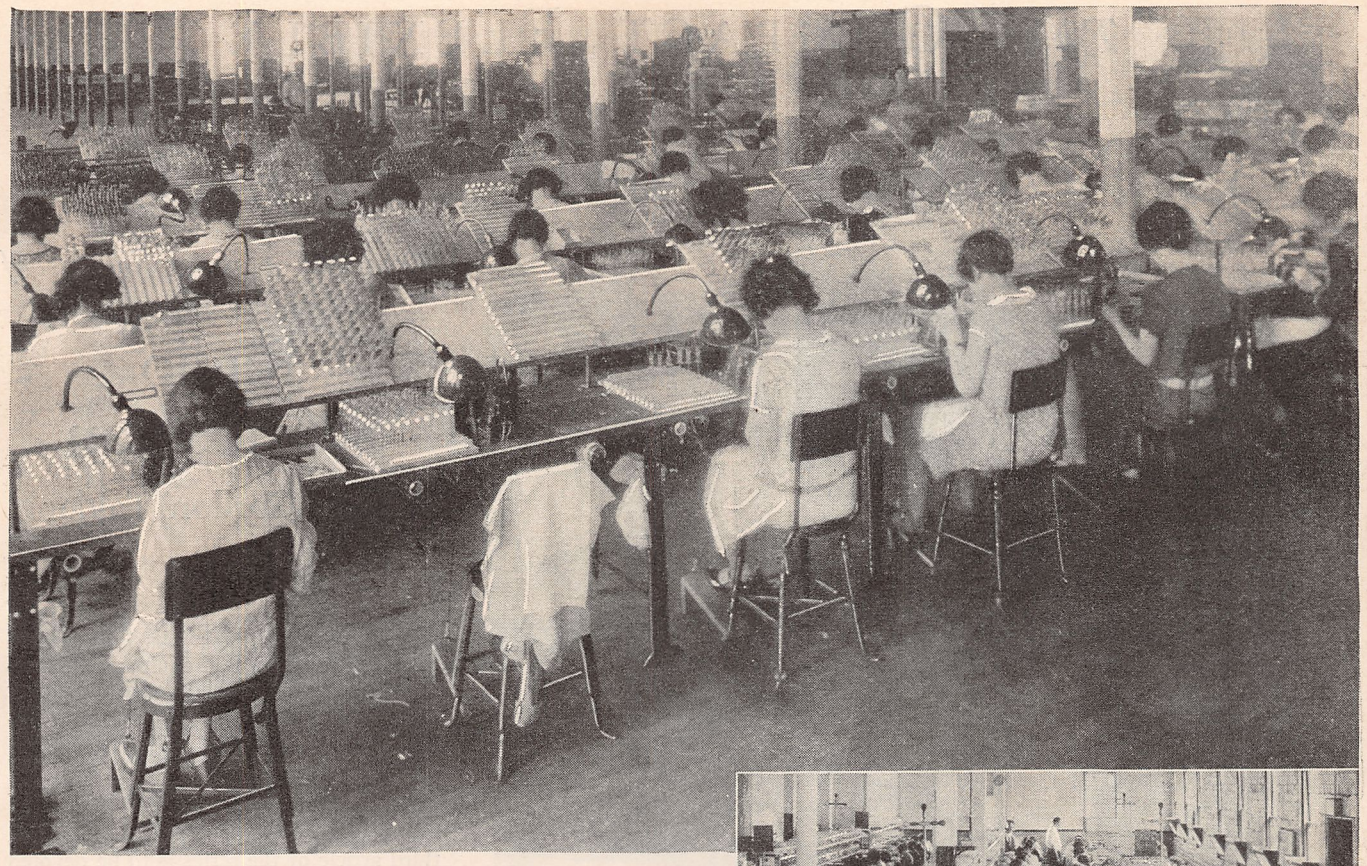
Photographs on these two pages by courtesy of Sylvania Products Co., Duovac Radio Tube Corp., Triad Mfg. Co., Inc., Ceco Mfg. Co., Inc., R. C. A., National Carbon Co., Cable Radio Tube Corporation

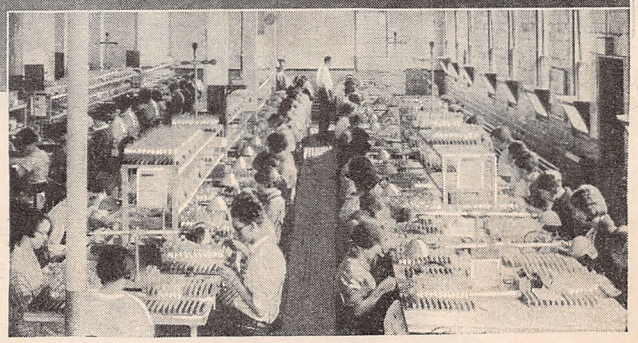


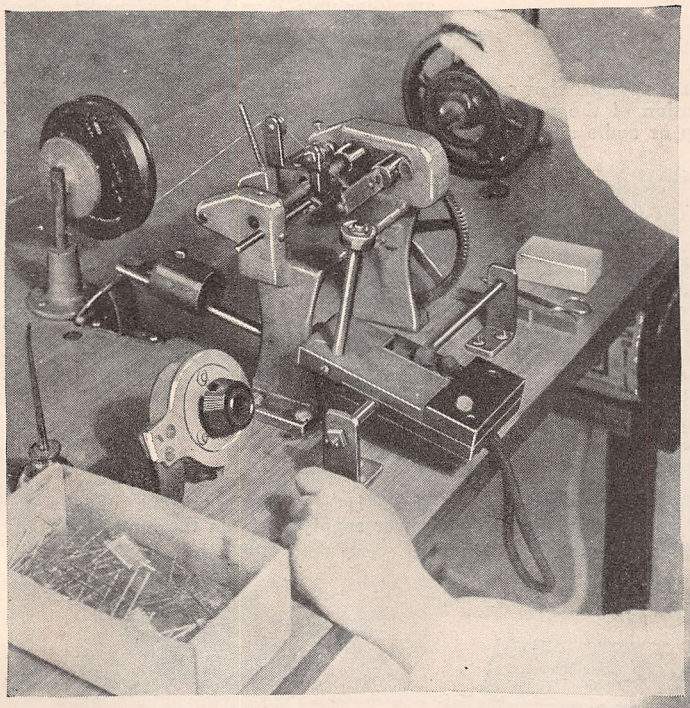


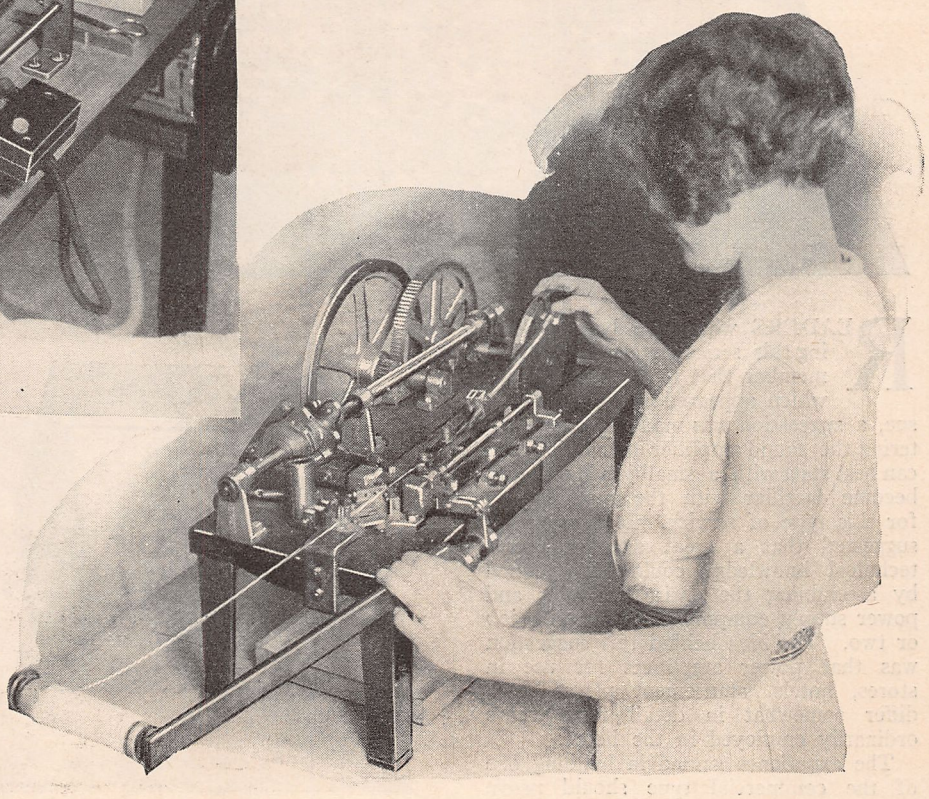
each position in a receiver got definitely under way. That marked the beginning of a financially successful day for radio.

Note what happened to the tube sales in 1928, the year that saw the introduction (in volume) of the a. c. tubes. Sales jumped nearly double over 1927 (from $67,000,000 to about $112,000,000) and the full buying power of the public, as measured from the standpoint of the replacement of battery-operated tubes with the a. c. types, had, at the end of 1928,









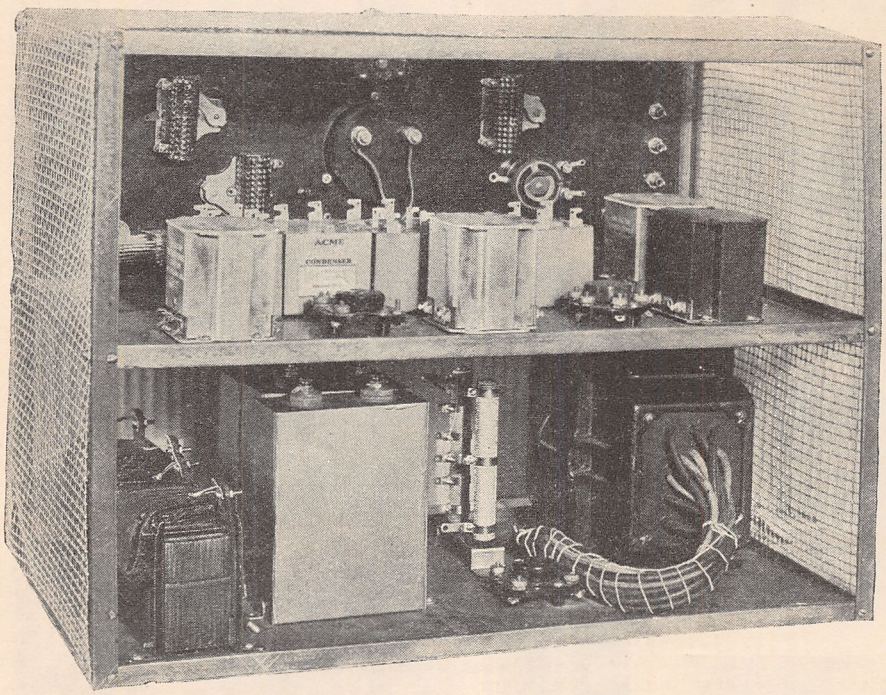
scarcely gotten under way. With production of receivers well under way, with orders from dealers mounting on the manufacturers' books, and bearing in mind that an average of six tubes is required for each new receiver, and the further fact that replacements form the basis for even more tube sales, it will probably not be difficult to see that the future opportunities of the tube-making industry may be numbered among the great.

# *This* COMPACT FLEXIBLE SPEECH AMPLIFIER

*Provides a New Source of Income for the*

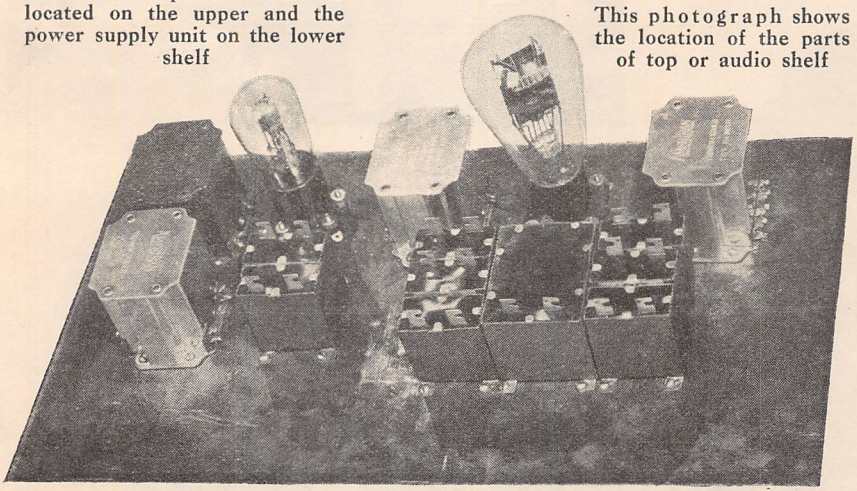
## Radio Serviceman

By S. Gordon Taylor



The audio amplifier channel is located on the upper and the power supply unit on the lower shelf

This photograph shows the location of the parts of top or audio shelf



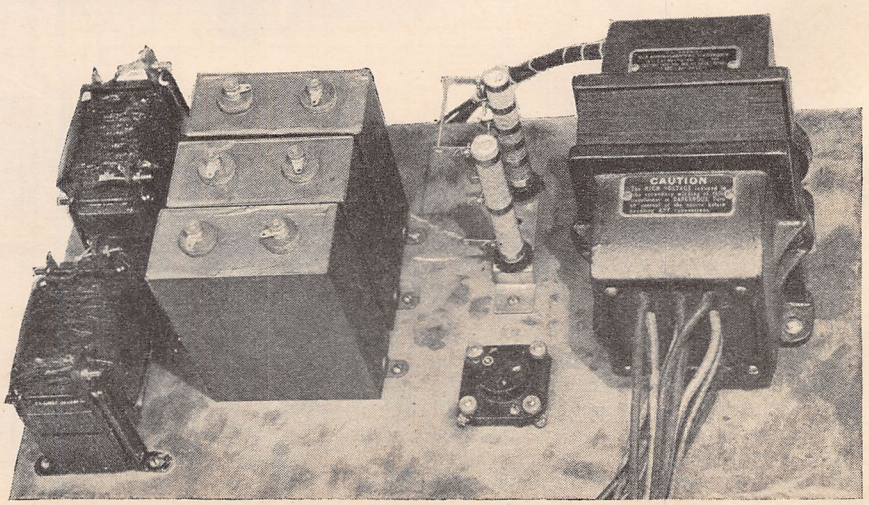
READERS who have been following this series of articles will remember that in the first article, which appeared in the August issue, a suggestion was made that those entering the sound amplifier installation field can best start with a small job in order to become familiar with the requirements for this type of service. It was further suggested that a great deal of useful technical knowledge could be obtained by assembling the entire amplifier and power supply equipment for the first job or two. The idea behind this suggestion was that power amplifiers for use in stores, hotels, amusement places, etc., differ somewhat in detail from those ordinarily employed in the home.

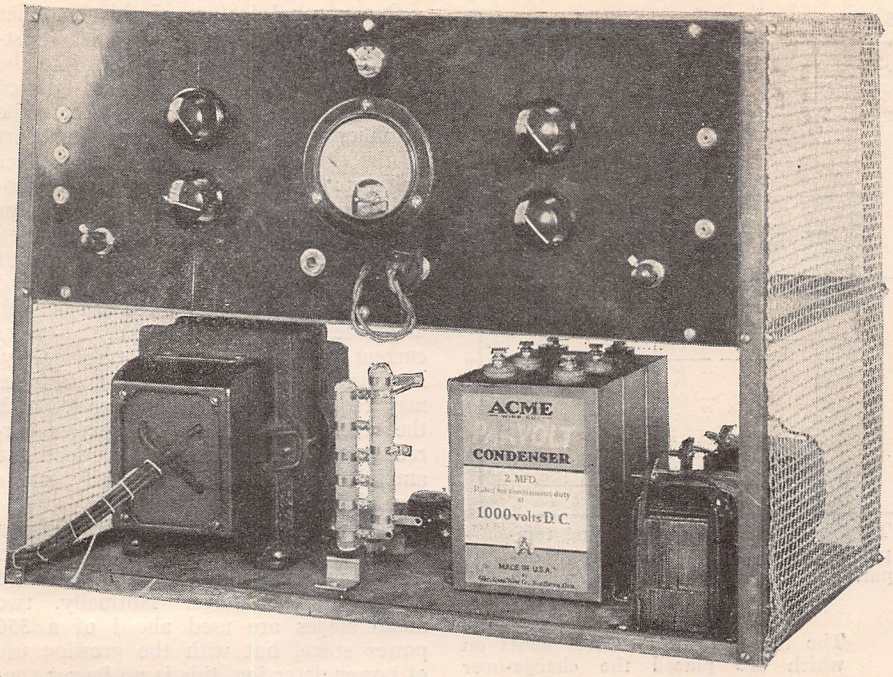
The experience gained in building one of the commercial type should prove helpful when for later jobs it is desired to select manufactured equipment. Moreover, the detailed knowledge of every function and part of the equipment makes the installation man better able to cope with any emergencies that may arise in installations employing standard manufactured equipment.

With the foregoing idea in mind, this third article of the series is to be devoted to a description of a complete power amplifier unit, especially designed to meet the requirements of commercial service. This unit is intended for installation where the volume and the coverage desired do not require such a high power output as could be supplied by a push-pull 250 job, but where more power is required than can be provided by the average radio receiver which does not employ an external power amplifier.

This description is not offered as a standard to be followed in exact detail for all medium sized installations. While it will probably serve to excellent advantage in the majority of such cases, it will in others require some minor changes

Here is shown the layout of the power supply parts on the metal base plate





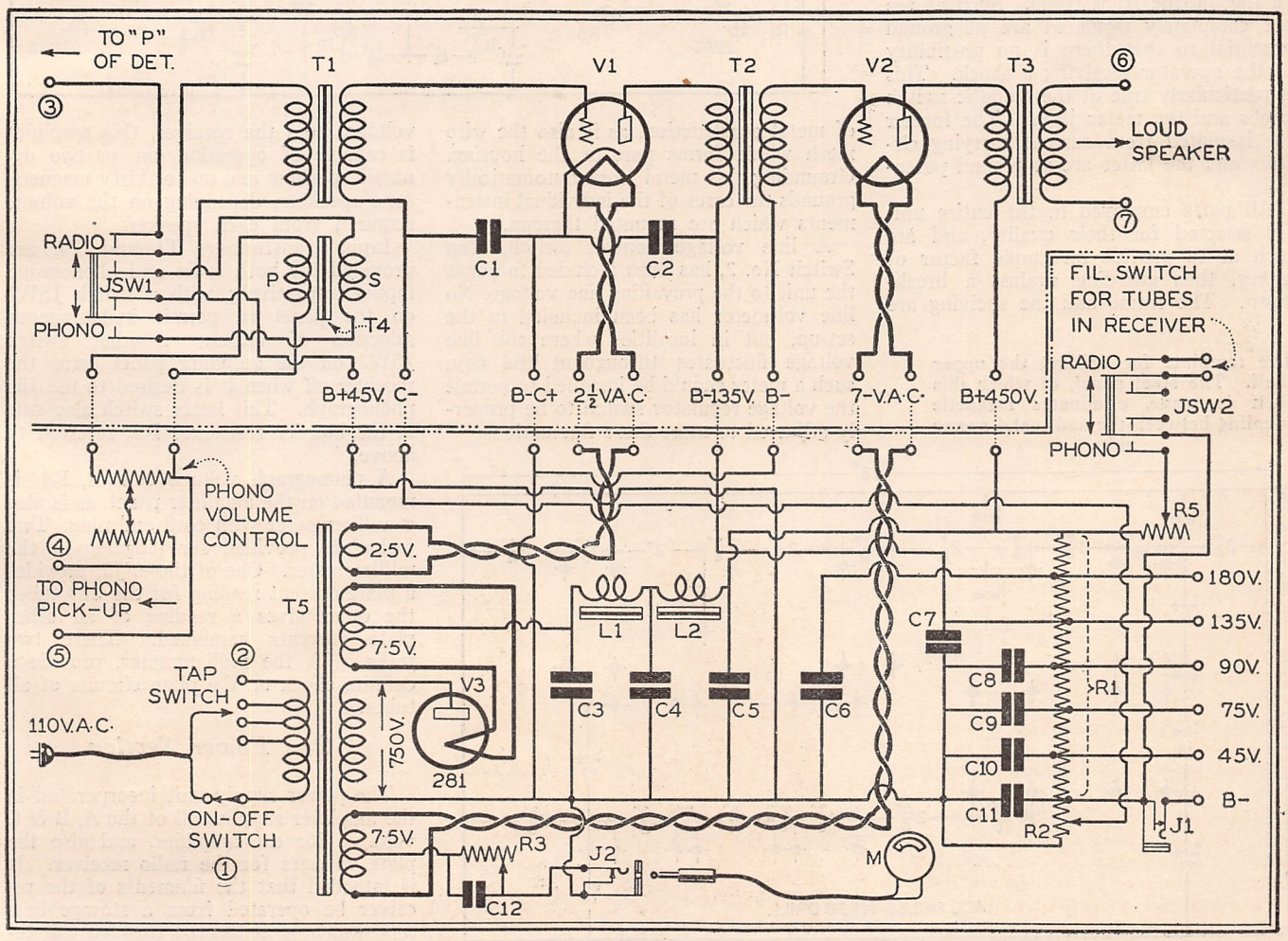

All controls are easily accessible, being mounted on the panel. A wire screen covers the lower front

to adapt it to the particular requirements of a given job. In any event, the description will serve to point out some of the special requirements called for by equipment which is to be used in commercial service. So far as the writer knows, some of these special features have never been included in descriptive articles published heretofore.

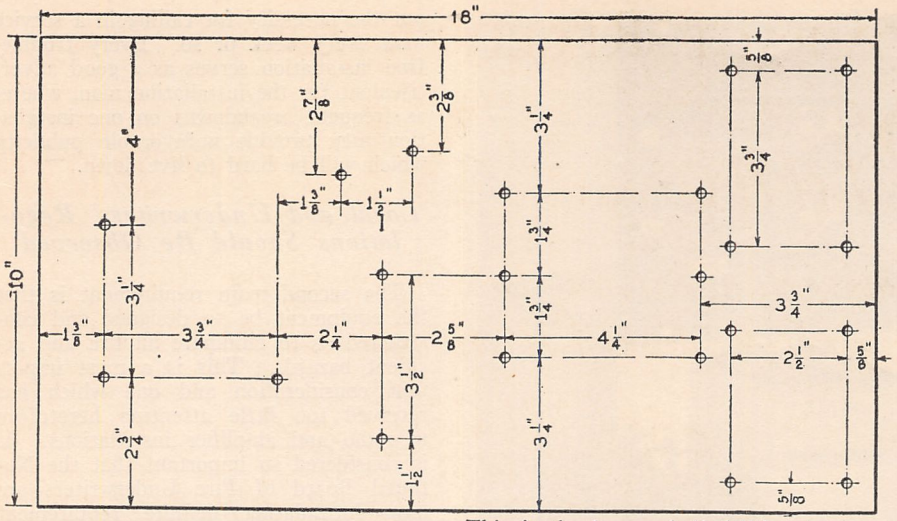
Commercial amplifiers, a convenient term to distinguish equipment used in schools, hotels, etc., from that ordinarily employed in the home, involves special considerations. One of the first requirements is that such equipment be made foolproof, because in almost every case it is to be operated by someone who knows nothing about its technicalities. Obviously, the owner wants to feel that he can expect continuous service without the necessity for calling in a service man every week or so. Every trouble-free installation serves as a good advertisement for the installation man, whereas frequent breakdowns on one installation may provide unfavorable publicity which will be hard to live down.

### *Local and Underwriters' Regulations Should Be Observed*

The second main requirement is that the equipment be so designed and constructed as to eliminate all fire and accident hazards. This is a most important consideration and one which has received too little attention heretofore in radio and amplifier installations. It is considered so important that the National Board of Fire Underwriters are now formulating definite requirement standards. Final requirements have not been released as yet, but some of the tentative rules have been published, and in designing the amplifier described below, these tentative requirements have been kept in mind. In this connection it is suggested that installation men consult local boards or building inspectors to determine any special local requirements that may exist. Some of these agencies have formulated very definite standards which must be followed.




The complete schematic circuit of the speech amplifier, power supply device. By means of the switches shown, ready changeover from radio to electric phonograph is possible




This is the lower shelf drilling template for the power and filter apparatus; all holes are drilled with a No. 28 drill

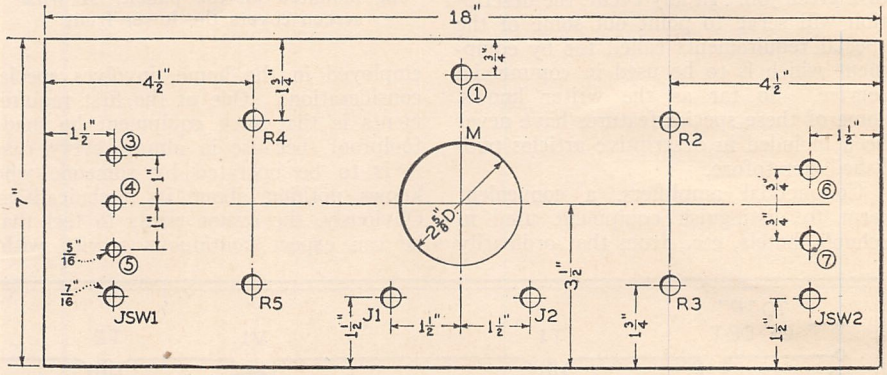
## *Unique Constructional Features Embodied in Design*

It may be well to start the description with a brief summary of the outstanding features embodied in this amplifier. In the first place, the entire unit is enclosed, but at the same time adequate ventilation is provided to dissipate the normal operating heat. Such enclosure is one of the few definite requirements of the Board of Underwriters. It prevents the operator from coming in contact with live parts; it protects the equipment itself from injury, and eliminates the fire hazard which may sometimes result from loose connections in high potential circuits.

All controls, switches, etc., are mounted on the outside front panel. Such as are not completely insulated are at ground potential so that there is no possibility of the operator receiving a shock. This is particularly true of the metallic switch knobs and the meter jacks. The former are insulated from current carrying circuits and the latter are at ground potential.

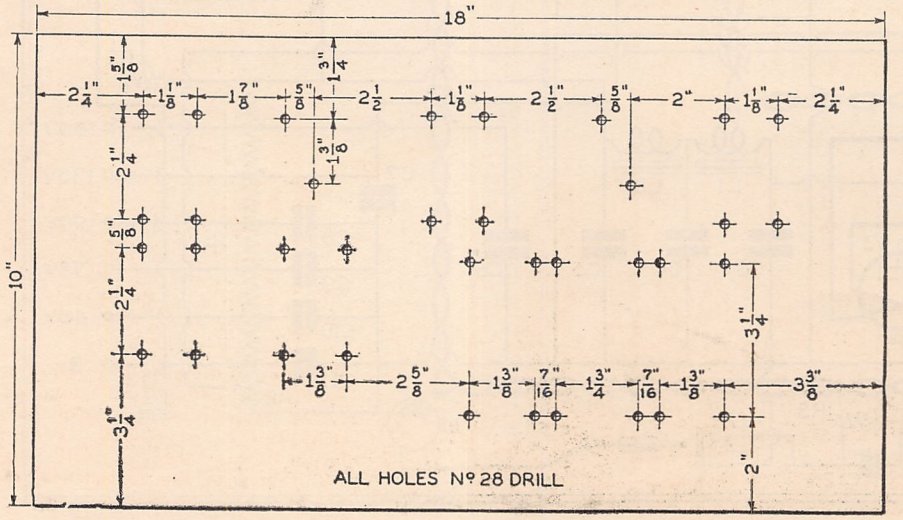
All parts employed in the entire unit are selected for their quality, and are such as to provide an ample factor of safety, thus guarding against a breakdown. The frame and the shelving are of metal construction, as is also the wire mesh which forms part of the housing. Grounding this metal work automatically grounds the cases of the individual instruments which are mounted thereon.

The layout of the control panel on which are placed the change-over switches, grid bias resistors, plate jacks, etc.




A line voltage control switch, Tap Switch No. 2, has been included to adapt the unit to the prevailing line voltage. No line voltmeter has been included in the set-up, but in localities where the line voltage fluctuates throughout the day, such a meter should be installed to permit the voltage regulator switch to be properly adjusted to meet these fluctuations.

The template for drilling the upper shelf. The steel panel, of which this shelf is made, eliminates magnetic coupling between the audio and power units




One unusual feature of this amplifier is found in the use of a bleeder resistance, which is automatically cut into the circuit when the radio receiver is turned off. This is required in cases where the amplifier is used with a phonograph part of the time. Inasmuch as the amplifier unit supplies plate voltages for a radio-frequency tuner, the plate voltages for the amplifier tubes would be increased when the tuner is turned off because of the decreased load. If the tuner employed contains only two or three tubes with low plate current consumption, the excess current would be little cause for worry. In many cases, however, the r. f. tubes may require 8 to 20 milliamperes. With the receiver turned off, this excess current would be sufficient to overload the amplifier tubes and eventually cause breakdowns.

The amplifier, as will be seen from a study of the schematic diagram, includes two stages with a single 350 power tube in the second stage. Normally, two audio stages are used ahead of a 350 power stage, but with the growing use of power detection, this is no longer considered necessary. With suitable input voltage from the receiver, this amplifier is capable of operating one or two dynamic speakers and up to thirty magnetic cone speakers, depending on the volume required from each speaker.

Input transformers T1 and T4, are provided for both radio and phonograph inputs respectively, with a switch JSW1 on the panel to permit instantaneous selection of either. Another switch JSW2 on the amplifier panel turns the receiver off when it is desired to use the phonograph. This latter switch also cuts in the bleeder resistance R5, referred to above.

A phonograph volume control, R4, is mounted on the amplifier panel, as is also a milliammeter with cord and plug. Two jacks are provided for plugging in the milliammeter. One of these, J2, provides a plate current reading for the 350 tube; the other gives a reading of all other plate currents combined. These two jacks, with the milliammeter, provide a definite check on the plate circuits of all tubes.

## *One Power Section*

The power supply unit incorporated in the amplifier supplies all of the A, B & C voltages for the amplifier, and also the plate voltages for the radio receiver. It is intended that the filaments of the receiver be operated from a storage battery which is connected through the re-

*(Continued on page 378)*

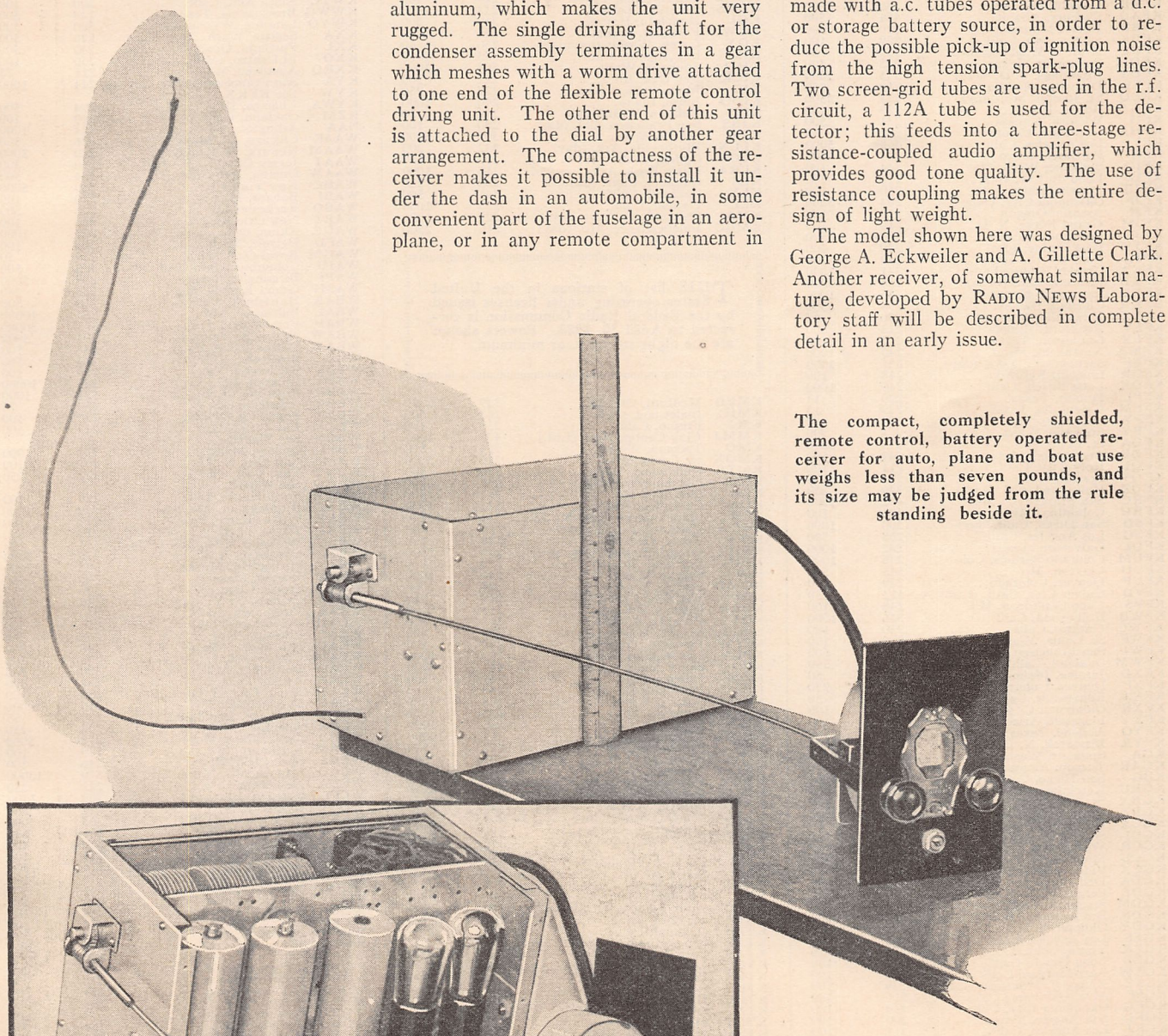
# A COMPACT RECEIVER *for* *Auto, Plane* OR *Motorboat*

## *Entire Broadcast Range Can Be Covered by This Single-Dial Receiver Equipped With Remote Control*

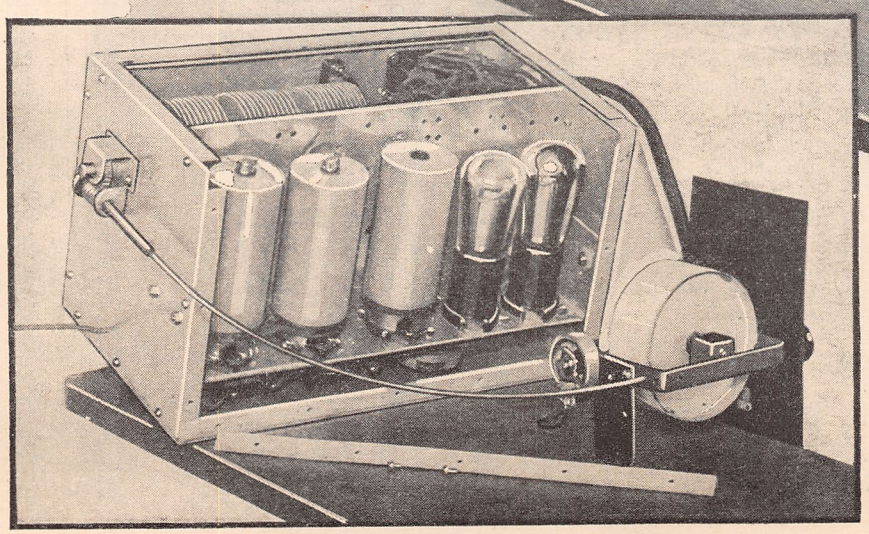
FROM the photographs it will be seen that the receiver illustrated here is extremely compact. The antenna required is very short. The entire antenna length is illustrated in the top view, and as may be observed by comparing it with the foot-rule standing beside the receiver, has a total length of approximately three feet. The entire case is made of angle aluminum and sheet aluminum, which makes the unit very rugged. The single driving shaft for the condenser assembly terminates in a gear which meshes with a worm drive attached to one end of the flexible remote control driving unit. The other end of this unit is attached to the dial by another gear arrangement. The compactness of the receiver makes it possible to install it under the dash in an automobile, in some convenient part of the fuselage in an aeroplane, or in any remote compartment in a motorboat away from a source of interference.

The volume control and tuning control may be carried to the dash or any other convenient place. The receiver itself is made with a.c. tubes operated from a d.c. or storage battery source, in order to reduce the possible pick-up of ignition noise from the high tension spark-plug lines. Two screen-grid tubes are used in the r.f. circuit, a 112A tube is used for the detector; this feeds into a three-stage resistance-coupled audio amplifier, which provides good tone quality. The use of resistance coupling makes the entire design of light weight.

The model shown here was designed by George A. Eckweiler and A. Gillette Clark. Another receiver, of somewhat similar nature, developed by RADIO NEWS Laboratory staff will be described in complete detail in an early issue.



**The compact, completely shielded, remote control, battery operated receiver for auto, plane and boat use weighs less than seven pounds, and its size may be judged from the rule standing beside it.**



**With two of the outside surfaces of the combination shield and container removed the position of most of the units may well be visualized. From this layout other designs will suggest themselves to the experienced radio constructor.**

# List of Broadcast Stations in the United States and Canada

*(Alphabetically, by Call Letters)*

| Radio Call Letters | BROADCAST STA. Location | Wave (Meters) | Power (Watts) |
|---|---|---|---|
| KCRC | Enid, Okla. | 219 | 100 |
| KDB | Santa Barbara, Calif. | 200 | 100 |
| KDKA | East Pittsburgh, Pa. | 306 | 50000 |
| KDLR | Devils Lake, N. D. | 248 | 100 |
| KDYL | Salt Lake City, Utah | 232 | 1000 |
| KEJK | Los Angeles, Calif., (Ltd.) | 256 | 500 |
| KELW | Burbank, Calif. | 384 | 500 |
| KEX | Portland, Oregon | 254 | 5000 |
| KFAB | Lincoln, Nebraska | 389 | 5000 |
| KFAD | Phoenix, Arizona | 484 | 500 |
| KVBB | Harve, Montana | 220 | 500 |
| KFBK | Sacramento, Calif. | 229 | 100 |
| KFBL | Everett, Washington | 219 | 50 |
| KFDM | Beaumont, Texas | 535 | 500 |
| KFDY | Brookings, S. D. (day) | 545 | 1000 |
| KFEL | Denver, Colorado | 319 | 250 |
| KFEQ | St. Joseph, Mo. (day) | 535 | 2500 |
| KFGQ | Boone, Iowa | 229 | 100 |
| KFH | Wichita, Kansas | 231 | 500 |
| KFHA | Gunnison, Colorado | 250 | 50 |
| KFI | Los Angeles, Calif. | 468 | 5000 |
| KFIF | Portland, Oregon | 211 | 500 |
| KFIO | Spokane, Wash. (day) | 244 | 100 |
| KFIZ | Fond du Lac, Wis. | 211 | 100 |
| KFJB | Marshalltown, Iowa | 250 | 100 |
| KFJF | Oklahoma City, Okla. | 204 | 5000 |
| KFJI | Astoria, Oregon | 219 | 100 |
| KFJM | Grand Forks, N. D. | 219 | 100 |
| KFJR | Portland, Oregon | 231 | 500 |
| KFJY | Fort Dodge, Iowa | 229 | 100 |
| KFJZ | Fort Worth, Texas | 219 | 100 |
| KFKA | Greeley, Colorado (day) | 341 | 1000 |
| KFKB | Milford, Kansas (day) | 286 | 5000 |
| KFKU | Lawrence, Kansas | 246 | 1000 |
| KFKX | Chicago, Illinois | 294 | 5000 |
| KFKZ | Kirksville, Missouri | 250 | 15 |
| KFLV | Rockford, Illinois | 213 | 500 |
| KFLX | Galveston, Texas | 219 | 100 |
| KFMX | Northfield, Minn. | 240 | 1000 |
| KFNF | Shenandoah, Iowa (day) | 337 | 1000 |
| KFOR | Lincoln, Nebraska | 248 | 100 |
| KFOX | Long Beach, Calif. | 240 | 1000 |
| KFPL | Dublin, Texas | 229 | 15 |
| KFPM | Greenville, Texas | 229 | 15 |
| KFPW | Siloam Springs, Ark. (day) | 224 | 50 |
| KFPY | Spokane, Wash. | 224 | 500 |
| KFQA | St. Louis, Mo | 275 | 5000 |
| KFQD | Anchorage, Alaska | 244 | 100 |
| KFQU | Holy City, Calif. | 211 | 100 |
| KFQW | Seattle, Wash | 211 | 100 |
| KFQZ | Hollywood, Cal. (Ltd.) | 349 | 250 |
| KFRC | San Francisco, Calif. | 492 | 1000 |
| KFRU | Columbia, Missouri | 476 | 500 |
| KFSD | San Diego, Calif. (day) | 500 | 1000 |
| KFSG | Los Angeles, Calif. | 268 | 500 |
| KFUL | Galveston, Texas | 232 | 1000 |
| KFUM | Colorado Springs, Colo | 236 | 1000 |
| KFUO | Clayton, Mo | 545 | 500 |
| KFUP | Denver, Colorado | 229 | 100 |
| KFVD | Culver City, Calif. (Ltd.) | 422 | 250 |
| KFVS | Cape Girardeau, Mo. | 248 | 100 |
| KFWB | Hollywood, Calif | 316 | 1000 |
| KFWC | Ontario, Calif. | 250 | 100 |
| KFWF | St. Louis, Missouri | 250 | 100 |
| KFWI | San Francisco, Calif. | 322 | 500 |
| KFWM | Oakland, Calif. | 322 | 500 |
| KFXD | Jerome, Idaho | 211 | 50 |
| KFXF | Denver, Colorado | 319 | 250 |
| KFXJ | Edgewater, Colo. | 229 | 50 |
| KFXR | Oklahoma City, Okla. | 229 | 100 |
| KFXY | Flagstaff, Arizona | 211 | 100 |
| KFYO | Abilene, Texas | 211 | 100 |
| KFYR | Bismarck, N. D. | 545 | 500 |
| KGA | Spokane, Wash. | 204 | 5000 |
| KGAR | Tucson, Arizona | 219 | 100 |
| KBG | San Diego, Calif. | 220 | 250 |
| KGBU | Ketchikan, Alaska | 333 | 500 |
| KGBX | St. Joseph, Mo. | 219 | 100 |
| KGBZ | York, Nebraska | 322 | 500 |
| KGCA | Decorah, Iowa (day) | 236 | 50 |
| KGCI | San Antonio Texas | 219 | 100 |
| KGCR | Watertown, S. D. | 248 | 100 |
| KGCU | Mandan, N. D. | 250 | 100 |
| KGCX | Vida, Montana | 211 | 10 |
| KGDA | Dell Rapids, S. D. | 219 | 50 |
| KGDE | Fergus Falls, Minn. | 250 | 50 |
| KGDM | Stockton, Calif. (day) | 273 | 50 |
| KGDR | San Antonio, Texas | 200 | 100 |
| KGDY | Oldham, S. D. | 250 | 15 |
| KGEF | Los Angeles, Calif. | 231 | 1000 |
| KGEK | Yuma, Colo. | 250 | 50 |
| KGER | Long Beach, Calif. | 219 | 100 |
| KGEW | Fort Morgan, Colo | 250 | 100 |
| KGEZ | Kalispell, Montana | 229 | 100 |
| KGFF | Alva, Oklahoma | 211 | 100 |
| KGFG | Oklahoma City, Okla. | 219 | 100 |
| KGFI | San Angelo, Texas | 200 | 100 |
| KGFJ | Los Angeles, Calif. | 211 | 100 |
| KGFK | Hallock, Minnesota | 250 | 50 |
| KGFL | Raton, New Mexico | 219 | 50 |
| KGFW | Ravenna, Nebraska | 211 | 50 |
| KGFX | Pierre, S. D. (day) | 517 | 200 |
| KGGC | San Francisco, Calf. | 211 | 50 |
| KGGF | Picher, Oklahoma | 297 | 500 |
| KGGM | Albuquerque, N. M. | 219 | 100 |
| KGHF | Pueblo, Colorado | 227 | 250 |
| KGHG | McGehee, Ark. | 229 | 50 |
| KGHI | Little Rock, Ark. | 200 | 100 |
| KGHL | Billings, Montana | 316 | 500 |
| KGHX | Richmond, Texas | 200 | 50 |
| KGIQ | Twin Falls, Idaho | 227 | 250 |
| KGIR | Butte, Montana | 220 | 250 |
| KGIW | Trinidad, Colo. | 211 | 100 |
| KGIX | Las Vegas, Nevada | 211 | 100 |
| KGJF | Little Rock, Ark. | 337 | 250 |
| KGKB | Brownwood, Texas | 200 | 100 |
| KGKL | San Angelo, Texas | 219 | 100 |
| KGKO | Wichita Falls, Texas | 526 | 250 |
| KGKX | Sandpoint, Idaho | 211 | 15 |
| KGO | Oakland, Calif. | 380 | 7500 |
| KGRC | San Antonio, Texas | 219 | 100 |
| KGRS | Amarillo, Texas | 213 | 1000 |
| KGU | Honolulu, Hawaii | 319 | 500 |
| KGW | Portland, Oregon | 484 | 1000 |
| KGY | Lacey, Washington (day) | 250 | 50 |
| KHJ | Los Angeles, Calif. | 333 | 1000 |
| KHQ | Spokane, Wash. | 508 | 1000 |
| KICK | Red Oak, Iowa | 211 | 100 |
| KID | Idaho Falls, Idaho | 227 | 250 |
| KIDO | Boise, Idaho | 240 | 1000 |
| KIT | Yakima, Washington | 219 | 50 |
| KJBS | San Francisco, Cal. (day) | 280 | 100 |
| KJR | Seattle, Wash. | 309 | 5000 |
| KLCN | Blytheville, Ark. (day) | 232 | 200 |
| KLO | Ogden, Utah | 219 | 100 |
| KLRA | Little Rock, Ark. | 216 | 1000 |
| KLS | Oakland, Calif. (day) | 208 | 250 |
| KLX | Oakland, Calif. | 341 | 500 |
| KLZ | Dupont, Colo. | 535 | 1000 |
| KMA | Shenandoah, Iowa (day) | 322 | 1000 |
| KMBC | Independence, Mo. (day) | 316 | 2500 |

THIS list of stations in the United States operating under licenses issued by the Federal Radio Commission is corrected to April 30, 1929. Powers shown are the night strength, or minimum.

| Radio Call Letters | BROADCAST STA. Location | Wave (Meters) | Power (Watts) |
|---|---|---|---|
| KMED | Medford, Oregon | 229 | 50 |
| KMIC | Inglewood, Calif. | 268 | 500 |
| KMJ | Fresno, Calif. | 250 | 100 |
| KMMJ | Clay Center, Neb. (Ltd.) | 405 | 1000 |
| KMO | Tacoma, Wash. | 224 | 500 |
| KMOX | St. Louis, Mo. | 275 | 5000 |
| KMTR | Hollywood, Calif. | 526 | 500 |
| KNX | Los Angeles, Calif. | 286 | 5000 |
| KOA | Denver, Colo. | 361 | 12500 |
| KOAC | Corvallis, Oregon | 535 | 1000 |
| KOB | State College, New Mexico | 254 | 10000 |
| KOCW | Chickasha, Okla., (day) | 214 | 500 |
| KOH | Reno, Nevada | 219 | 100 |
| KOIL | Council Bluffs, Iowa, (day) | 238 | 2500 |
| KOIN | Portland, Oregon | 319 | 1000 |
| KOL | Seattle, Wash. | 236 | 1000 |
| KOMO | Seattle, Wash. | 326 | 1000 |
| KOOS | Marshfield, Oregon | 219 | 50 |
| KORE | Eugene, Oregon | 211 | 100 |
| KOY | Phoenix, Arizona | 216 | 500 |
| KPCB | Seattle, Wash. | 248 | 100 |
| KPJM | Prescott, Arizona | 200 | 100 |
| KPLA | Los Angeles, Calif. | 300 | 1000 |
| KPO | San Francisco, Cal. | 441 | 5000 |
| KPOF | Denver, Colo. | 341 | 500 |
| KPPC | Pasadena, Calif. | 250 | 50 |
| KPQ | Seattle, Wash. | 248 | 100 |
| KPRC | Houston, Texas | 326 | 1000 |
| KPSN | Pasadena, Calif. | 316 | 1000 |
| KPWF | Westminster, Cal. | 214 | 10000 |
| KQV | Pittsburgh, Pa. | 217 | 500 |
| KQW | San Jose, Calif. | 297 | 500 |
| KRE | Berkeley, Calif. | 219 | 100 |
| KRGV | Harlingen, Texas | 238 | 500 |
| KRLD | Dallas, Texas | 288 | 10000 |
| KRMD | Shreveport, La. | 229 | 50 |
| KRSC | Seattle, Wash. (day) | 268 | 50 |
| KSAC | Manhattan, Kans. (day) | 517 | 1000 |
| KSCJ | Sioux City, Iowa | 225 | 1000 |
| KSD | St. Louis, Mo. | 545 | 500 |
| KSEI | Pocatello, Idaho | 333 | 250 |
| KSL | Salt Lake City, Utah | 265 | 5000 |
| KSMR | Santa Maria, Calif. | 250 | 100 |
| KSO | Clarinda, Iowa | 217 | 1000 |
| KSOO | Sioux Falls, S. D. (day) | 270 | 2000 |
| KSTP | St. Paul, Minn. | 205 | 10000 |
| KTAB | Oakland, Calif. | 545 | 500 |
| KTAP | San Antonio, Texas | 211 | 100 |
| KTAT | Fort Worth, Texas | 242 | 1000 |
| KTBI | Los Angeles, Calif. | 231 | 750 |
| KTBR | Portland, Oregon | 231 | 500 |
| KTBS | Shreveport, La. | 207 | 500 |
| KTHS | Hot Springs, Ark. | 288 | 1000 |
| KTM | Santa Monica, Calif. | 428 | 500 |
| KTNT | Muscatine, Iowa (day) | 256 | 5000 |
| KTSA | San Antonio, Texas (day) | 232 | 2000 |
| KTSL | Shreveport, La | 229 | 100 |
| KTUE | Houston, Texas | 211 | 5 |
| KTW | Seattle, Wash. | 236 | 1000 |
| KUJ | Seattle, Wash. | 200 | 10 |
| KUOA | Fayetteville, Ark. | 216 | 1000 |
| KUOM | Missoula, Mont. | 526 | 500 |
| KUSD | Vermillion, S. D. (day) | 337 | 750 |
| KUT | Austin, Texas | 268 | 500 |
| KVI | Des Moines, Wash. | 394 | 1000 |
| KVL | Seattle, Wash. | 219 | 100 |
| KVOA | Tucson, Ariz., (day) | 211 | 500 |
| KVOO | Tulsa, Okla. | 263 | 5000 |
| KVOS | Bellingham, Wash. | 250 | 100 |
| KWBS | Portland, Oregon | 200 | 15 |
| KWCR | Cedar Rapids, Iowa | 229 | 100 |
| KWEA | Shreveport, La. | 248 | 100 |
| KWJJ | Portland, Ore. (Ltd.) | 283 | 500 |
| KWK | St. Louis, Mo. | 222 | 1000 |
| KWKC | Kansas City, Mo. | 219 | 100 |
| KWKH | Kennonwood, La. | 353 | 20000 |
| KWLC | Decorah, Iowa (day) | 236 | 100 |
| KWSC | Pullman, Wash. | 216 | 500 |
| KWTC | Santa Ana, Calif. | 200 | 100 |
| KWWG | Brownsville, Texas | 238 | 500 |
| KWYO | Laramie, Wyoming | 500 | 500 |
| KXA | Seattle, Wash. | 526 | 500 |
| KXL | Portland, Oregon | 240 | 500 |
| KXO | El Centro, Calif. | 250 | 100 |
| KXRO | Aberdeen, Wash. | 211 | 75 |
| KYA | San Francisco, Calif. | 244 | 1000 |
| KYW | See KFKX | | |
| KYWA | Chicago, Ill | 294 | 500 |
| KZM | Oakland, Calif. | 219 | 100 |
| NAA | Arlington, Va. | 434 | 1000 |
| WAAF | Chicago, Ill. (day) | 326 | 500 |
| WAAM | Newark, N. J. (day) | 240 | 2000 |
| WAAT | Jersey City, N. J. (day) | 280 | 300 |
| WAAW | Omaha, Neb. (day) | 454 | 500 |
| WABC | New York City | 349 | 5000 |
| WABI | Bangor, Me. | 250 | 100 |
| WABO | Rochester, N. Y. | 208 | 500 |
| WABZ | New Orleans, La. | 250 | 100 |
| WADC | Akron, Ohio | 227 | 1000 |
| WAFD | Detroit, Mich. | 200 | 100 |
| WAGM | Royal Oak, Mich. | 229 | 50 |
| WAIU | Columbus, Ohio (Ltd.) | 468 | 500 |
| WAPI | Birmingham, Ala. | 263 | 5000 |
| WASH | Grand Rapids, Mich. | 236 | 250 |
| WBAK | Harrisburg, Pa. (day) | 210 | 500 |
| WBAL | Baltimore, Md. | 283 | 10000 |
| WBAP | Fort Worth, Texas (LP) | 375 | 50000 |
| WBAW | Nashville, Tenn. | 201 | 5000 |
| WBAX | Wilkes-Barre, Pa. | 248 | 100 |
| WBBC | Brooklyn, N. Y. City | 214 | 500 |
| WBBL | Richmond, Va. | 219 | 100 |
| WBBM | Chicago, Ill. | 389 | 10000 |
| WBBR | Rossville, N. Y. City | 231 | 1000 |
| WBBY | Charleston, S. C. | 250 | 75 |
| WBBZ | Ponca City, Okla. | 250 | 100 |
| WBCM | Bay City, Mich. | 213 | 500 |
| WBCN | See WENR | | |
| WBIS | Quincy, Mass. | 244 | 1000 |
| WBMS | Fort Lee, N. J. | 207 | 200 |
| WBNY | New York City | 222 | 250 |
| WBOQ | See WABC | | |
| WBOW | Terre Haute, Ind. | 229 | 100 |
| WBRC | Birmingham, Ala. (day) | 322 | 1000 |
| WBRE | Wilkes-Barre, Pa. | 229 | 100 |
| WBRL | Tilton, N. H. | 210 | 500 |
| WBSO | Wellesley Hills, Mass. (day) | 384 | 250 |
| WBT | Charlotte, N. C. | 278 | 5000 |
| WBZ | Springfield, Mass. | 303 | 15000 |
| WBZA | Boston, Mass. | 303 | 500 |
| WCAC | Storrs, Conn. | 500 | 250 |
| WCAD | Canton, N. Y. (day) | 246 | 500 |
| WCAE | Pittsburgh, Pa. | 246 | 500 |
| WCAH | Columbus, Ohio | 210 | 500 |
| WCAJ | Lincoln, Neb. | 508 | 500 |
| WCAL | Northfield, Minn. | 240 | 1000 |
| WCAM | Camden, N. J. | 234 | 500 |
| WCAO | Baltimore, Md. | 500 | 250 |
| WCAP | Asbury Park, N. J. | 234 | 500 |
| WCAT | Rapid City, S. D. | 250 | 100 |
| WCAU | Philadelphia, Pa. | 256 | 10000 |
| WCAZ | Carthage, Ill. (day) | 280 | 50 |
| WCBA | Allentown, Pa. | 208 | 250 |
| WCBD | Zion, Illinois (day) | 278 | 5000 |
| WCBM | Baltimore, Md. | 219 | 100 |
| WCBS | Springfield, Ill. | 248 | 100 |
| WCCO | Minneapolis, Minn. | 370 | 15000 |
| WCDA | New York City | 222 | 250 |
| WCFL | Chicago, Ill. (Ltd.) | 309 | 1500 |
| WCGU | Brooklyn, N. Y. City | 214 | 500 |
| WCKY | Villa Madonna, Ky | 203 | 5000 |
| WCLB | Long Beach, N.Y. | 200 | 100 |
| WCLO | Kenosha, Wis. | 250 | 100 |
| WCLS | Joliet, Ill. | 229 | 100 |
| WCMA | Culver, Ind. | 214 | 500 |
| WCOA | Pensacola, Fla. | 268 | 500 |
| WCOC | Columbus, Miss. | 341 | 500 |
| WCOD | Harrisburg, Pa. | 250 | 100 |
| WCOH | Greenville, N. Y. | 248 | 100 |
| WCRW | Chicago, Ill. | 248 | 100 |
| WCSH | Portland, Maine | 319 | 500 |
| WCSO | Springfield, Ohio | 217 | 500 |
| WDAE | Tampa, Fla. | 484 | 1000 |
| WDAF | Kansas City, Mo. | 492 | 1000 |
| WDAG | Amarillo, Texas | 213 | 250 |
| WDAH | El Paso, Texas | 229 | 100 |
| WDAY | Fargo, N. D. | 234 | 1000 |
| WDBJ | Roanoke, Va. (day) | 322 | 500 |
| WDBO | Orlando, Fla. | 484 | 1000 |
| WDEL | Wilmington, Del. (day) | 268 | 350 |
| WDGY | Minneapolis, Minn. (Ltd.) | 254 | 1000 |
| WDOD | Chattanooga, Tenn. | 234 | 500 |
| WDRC | New Haven, Conn. | 225 | 500 |
| WDSU | New Orleans, La. | 236 | 1000 |
| WDWF | Cranston, R. I. | 248 | 100 |
| WDZ | Tuscola, Illinois, (day) | 280 | 100 |
| WEAF | New York City (LP) | 454 | 50000 |
| WEAI | Ithaca, N. Y. (day) | 236 | 1000 |
| WEAN | Providence, R. I. (day) | 545 | 500 |
| WEAO | Columbus, Ohio | 545 | 750 |
| WEAR | Cleveland, Ohio | 280 | 1000 |
| WEBC | Superior, Wis. | 234 | 1000 |
| WEBE | Cambridge, Ohio | 248 | 100 |
| WEBQ | Harrisburg, Ill. | 248 | 100 |
| WEBR | Buffalo, N. Y., (day) | 229 | 200 |

| Radio Call Letters | BROADCAST STA. Location | Wave (Meters) | Power (Watts) |
|---|---|---|---|
| WEBW | Beloit, Wis. (day) | 500 | 350 |
| WEDC | Chicago, Ill. | 248 | 100 |
| WEDH | Erie, Pa. | 211 | 30 |
| WEEI | Boston, Mass. | 508 | 500 |
| WEHS | Evanston, Ill. | 229 | 100 |
| WELK | Philadelphia, Pa. | 219 | 100 |
| WEMC | Berrien Springs, Mich. (day). | 508 | 1000 |
| WENR | Chicago, Ill. (LP) | 345 | 50000 |
| WEPS | Gloucester, Mass. | 250 | 100 |
| WEVD | New York City | 231 | 500 |
| WEW | St. Louis, Mo. (day) | 395 | 1000 |
| WFAA | Dallas, Texas (CP). | 375 | 500 500kw |
| WFAN | Philadelphia, Pa. | 492 | 500 |
| WFBC | Knoxville, Tenn. | 250 | 50 |
| WFBG | Altoona, Pa. | 229 | 100 |
| WFBJ | Collegeville, Minn. | 219 | 100 |
| WFBL | Syracuse, N. Y. | 333 | 750 |
| WFBM | Indianapolis, Ind. (Ltd.) | 244 | 1000 |
| WFBR | Baltimore, Md. (temp.) | 236 | 250 |
| WFDF | Flint, Michigan | 229 | 100 |
| WFI | Philadelphia, Pa. | 535 | 500 |
| WFIW | Hopkinsville, Ky. | 319 | 1000 |
| WFJC | Akron, Ohio | 207 | 500 |
| WFKD | Philadelphia, Pa. | 229 | 50 |
| WFLA | See WSUN | | |
| WGAL | Lancaster, Pa. | 229 | 15 |
| WGBB | Freeport, N. Y. | 248 | 100 |
| WGBC | Memphis, Tenn. | 210 | 500 |
| WGBF | Evansville, Ind. | 476 | 500 |
| WGBI | Scranton, Pa. | 341 | 250 |
| WGBS | New York City (Limited) | 254 | 500 |
| WGCM | Gulfport, Miss. | 248 | 100 |
| WGCP | Newark, N. J. | 240 | 250 |
| WGES | Chicago, Ill. | 220 | 500 |
| WGH | Newport News, Va. | 229 | 100 |
| WGHP | Fraser, Mich | 282 | 750 |
| WGL | Fort Wayne, Ind. | 219 | 100 |
| WGMS | See WLB | | |
| WGN | Chicago, Ill. | 416 | 25000 |
| WGR | Buffalo, N. Y. | 545 | 1000 |
| WGST | Atlanta, Ga. (day) | 337 | 250 |
| WGY | Schenectady, N. Y. | 380 | 50000 |
| WHA | Madison, Wis. (day) | 319 | 750 |
| WHAD | Milwaukee, Wis. | 268 | 250 |
| WHAM | Rochester, N. Y. | 261 | 5000 |
| WHAP | New York City | 231 | 1000 |
| WHAS | Louisville, Ky. | 366 | 5000 |
| WHAZ | Troy, N. Y. | 231 | 500 |
| WHBC | Canton, Ohio | 250 | 10 |
| WHBD | Bellefontaine, Ohio | 219 | 100 |
| WHBF | Rock Island, Ill. | 248 | 100 |
| WHBL | Sheboygan, Wis. | 213 | 500 |
| WHBP | Johnstown, Pa. | 229 | 100 |
| WHBQ | Memphis, Tenn. | 219 | 100 |
| WHBU | Anderson, Indiana | 248 | 100 |
| WHBY | West De Pere, Wis. (L. T.) | 250 | 100 |
| WHDF | Calumet, Mich. | 219 | 100 |
| WHDH | Gloucester, Mass. (day) | 361 | 1000 |
| WHDI | Minneapolis, Minn. (L. T.) | 254 | 1500 |
| WHDL | Tupper Lake, N. Y. (day) | 211 | 10 |
| WHEC | See WABO | | |
| WHFC | Cicero, Ill | 229 | 100 |
| WHIS | Bluefield, W. Va. | 211 | 100 |
| WHK | Cleveland, Ohio | 216 | 1000 |
| WHN | New York City | 297 | 250 |
| WHO | Des Moines, Iowa | 300 | 5000 |
| WHP | Harrisburg, Pa. | 210 | 500 |
| WIAS | Ottumwa, Iowa | 211 | 100 |
| WIBA | Madison, Wis. | 248 | 100 |
| WIBG | Elkins Park, Pa. (day) | 322 | 50 |
| WIBM | Jackson, Mich. | 219 | 100 |
| WIBO | Chicago, Ill. | 526 | 1000 |
| WIBR | Steubenville, Ohio. | 211 | 50 |
| WIBS | Elizabeth, N. J. | 207 | 250 |
| WIBU | Poynette, Wis. | 229 | 100 |
| WIBW | Topeka, Kans. | 231 | 1000 |
| WIBX | Utica, N. Y. | 250 | 100 |
| WICC | Bridgeport, Conn. (day) | 252 | 500 |
| WIL | St. Louis, Mo. | 250 | 100 |
| WILL | Urbana, Ill. | 337 | 250 |
| WILM | Wilmington, Del. | 211 | 100 |
| WINR | Bay Shore, N. Y. | 248 | 100 |
| WIOD | Miami Beach, Fla. | 535 | 1000 |
| WIP | Philadelphia, Pa. | 492 | 500 |
| WISN | Milwaukee, Wis. | 268 | 250 |
| WJAD | Waco, Texas | 242 | 1000 |
| WJAG | Norfolk, Neb. (day) | 283 | 1000 |
| WJAK | Marion, Ind. | 229 | 50 |
| WJAR | Providence, R. I. | 337 | 250 |
| WJAS | Pittsburgh, Pa. | 232 | 1000 |
| WJAX | Jacksonville, Fla. | 238 | 1000 |
| WJAY | Cleveland, Ohio (day) | 484 | 500 |
| WJAZ | Chicago, Ill. | 203 | 5000 |
| WJBC | LaSalle, Ill. | 250 | 100 |
| WJBI | Red Bank, N. J. | 248 | 100 |
| WJBK | Ypsilanti, Mich. | 219 | 50 |
| WJBL | Decatur, Ill. | 250 | 100 |
| WJBO | New Orleans, La. | 219 | 100 |
| WJBT | See WBBM | | |
| WJBU | Lewisburg, Pa. | 248 | 100 |
| WJBW | New Orleans, La. | 250 | 30 |
| WJBY | Gadsden, Ala. | 248 | 50 |
| WJJD | Mooseheart, Ill. (Ltd.) | 265 | 20000 |
| WJKS | Gary, Ind. | 220 | 500 |
| WJR | Pontiac, Mich. | 400 | 5000 |
| WJSV | Mt. Vernon Hills, Va. | 205 | 10000 |
| WJW | Mansfield, Ohio. | 248 | 100 |
| WJZ | New York City (L. P.) | 395 | 30000 |
| WKAQ | San Juan, Porto Rico | 337 | 500 |
| WKAR | East Lansing, Mich. (day) | 288 | 1000 |
| WKAV | Laconia, N. H. | 229 | 100 |
| WKBB | Joliet, Ill. | 229 | 100 |
| WKBC | Birmingham, Ala. | 229 | 100 |
| WKBE | Webster, Mass. | 250 | 100 |
| WKBF | Indianapolis, Ind. | 214 | 500 |
| WKBH | La Crosse, Wis. | 217 | 1000 |
| WKBI | Chicago, Ill. | 229 | 50 |
| WKBN | Youngstown, Ohio. | 526 | 500 |
| WKBO | Jersey City, N. J. | 207 | 250 |
| WKBP | Battle Creek, Mich. | 211 | 50 |
| WKBQ | New York City. | 222 | 250 |
| WKBS | Galesburg, Ill. | 229 | 100 |
| WKBV | Brookville, Ind. | 200 | 100 |
| WKBW | Buffalo, N. Y. | 204 | 5000 |
| WKBZ | Ludington, Mich. | 200 | 50 |
| WKEN | Buffalo, N. Y. (Ltd.) | 288 | 1000 |
| WKJC | Lancaster, Pa. | 250 | 100 |
| WKRC | Cincinnati, Ohio | 545 | 500 |
| WKY | Oklahoma City, Okla. | 333 | 1000 |
| WLAC | Nashville, Tenn. | 201 | 5000 |
| WLAP | Louisville, Ky. | 250 | 30 |
| WLB | Minneapolis, Minn. | 240 | 500 |
| WLBC | Muncie, Ind. | 229 | 50 |
| WLBF | Kansas City, Mo. | 211 | 100 |
| WLBG | Ettrick, Va. | 250 | 100 |
| WLBL | Stevens Point, Wis. (day) | 333 | 2000 |
| WLBW | Oil City, Pa. | 238 | 500 |
| WLBX | Long Island City, N. Y. | 200 | 100 |
| WLBZ | Bangor, Maine. | 484 | 250 |
| WLCI | Ithaca, N. Y. | 248 | 50 |
| WLEX | Medford, Mass. | 220 | 500 |
| WLEY | Lexington, Mass. | 211 | 100 |
| WLIB | See WGN | | |
| WLIT | Philadelphia, Pa. | 535 | 500 |
| WLOE | Chelsea, Mass. | 200 | 100 |
| WLS | Chicago, Ill. | 345 | 5000 |
| WLSI | See WDWF | | |
| WLTH | Brooklyn, N. Y. | 214 | 500 |
| WLW | Cincinnati, Ohio (L.P.) | 428 | 50000 |
| WLWL | New York City. | 273 | 5000 |
| WMAC | Cazenovia, N. Y. | 526 | 250 |
| WMAF | So. Dartmouth, Mass. | 220 | 500 |
| WMAK | Buffalo, N. Y. | 333 | 750 |
| WMAL | Washington, D. C. | 476 | 250 |
| WMAN | Columbus, Ohio. | 248 | 50 |
| WMAQ | Chicago, Ill. | 447 | 5000 |
| WMAZ | Macon, Ga. | 337 | 250 |
| WMBA | Newport, R. I. | 200 | 100 |
| WMBC | Detroit, Mich. | 211 | 100 |
| WMBD | Peoria, Ill. | 208 | 500 |
| WMBG | Richmond, Va. | 248 | 100 |
| WMBH | Joplin, Mo. | 211 | 100 |
| WMBI | Chicago, Ill. (Ltd.) | 278 | 5000 |
| WMBJ | Wilkinsburg, Pa. | 200 | 100 |
| WMBL | Lakeland, Fla. | 229 | 100 |
| WMBO | Auburn, N. Y. | 219 | 100 |
| WMBQ | Brooklyn, N. Y. | 200 | 100 |
| WMBR | Tampa, Fla. | 248 | 100 |
| WMC | Memphis, Tenn. | 526 | 500 |
| WMCA | New York City. | 526 | 500 |
| WMES | Boston, Mass. | 200 | 50 |
| WMMN | Fairmont, W. Va. | 337 | 250 |
| WMPC | Lapeer, Mich. | 200 | 100 |
| WMRJ | Jamaica, N. Y. City | 211 | 10 |
| WMSG | New York City. | 222 | 250 |
| WMT | Waterloo, Iowa. | 250 | 100 |
| WNAC | See WBIS | | |
| WNAD | Norman, Okla. | 297 | 500 |
| WNAT | Philadelphia, Pa. | 229 | 100 |
| WNAX | Yankton, S. D. | 526 | 1000 |
| WNBF | Binghamton, N. Y. | 200 | 50 |
| WNBH | New Bedford, Mass. | 229 | 100 |
| WNBJ | Knoxville, Tenn. | 229 | 50 |
| WNBO | Washington, Pa. | 250 | 100 |
| WNBR | Memphis, Tenn. | 210 | 500 |
| WNBW | Carbondale, Pa. | 250 | 5 |
| WNBX | Springfield, Vt. | 250 | 10 |
| WNBZ | Saranac Lake, N. Y. (day) | 232 | 50 |
| WNJ | Newark, N. J. | 207 | 250 |
| WNOX | Knoxville, Tenn. | 535 | 1000 |
| WNRC | Greensboro, N. C. | 208 | 250 |
| WNYC | New York City. | 526 | 500 |
| WOAI | San Antonio, Texas. | 252 | 5000 |
| WOAN | Lawrenceburg, Tenn. | 500 | 500 |
| WOAX | Trenton, N. J. | 234 | 500 |
| WOBT | Union City, Tenn. | 229 | 15 |
| WOBU | Charleston, W. Va. | 517 | 250 |
| WOC | Davenport, Iowa. | 300 | 5000 |
| WOCL | Jamestown, N. Y. | 248 | 25 |
| WODA | Paterson, N. J. | 240 | 1000 |
| WOI | Ames, Iowa (day) | 535 | 3500 |
| WOKO | Mt. Beacon, N.Y. | 208 | 500 |
| WOL | Washington, D.C. | 229 | 100 |
| WOMT | Manitowoc, Wis. | 248 | 100 |
| WOOD | Grand Rapids, Mich. | 236 | 500 |
| WOPI | Bristol, Tenn | 200 | 100 |
| WOQ | Kansas City, Mo. | 492 | 1000 |
| WOR | Newark, N. J. | 422 | 5000 |
| WORD | Chicago, Ill. | 203 | 5000 |
| WOS | Jefferson City, Mo. | 476 | 500 |
| WOV | New York City (day) | 265 | 1000 |
| WOW | Omaha, Neb. | 508 | 1000 |
| WOWO | Fort Wayne, Ind. | 258 | 1000 |
| WPAP | New York City. | 297 | 250 |
| WPAW | Pawtucket, R. I. | 248 | 100 |
| WPCC | Chicago, Ill. | 526 | 500 |
| WPCH | New York City (day) | 370 | 500 |
| WPG | Atlantic City, N. J. | 273 | 5000 |
| WPOE | Patchogue, N. Y. | 211 | 30 |
| WPOR | See WTAR | | |
| WPSC | State College, Pa. (day) | 244 | 500 |
| WPSW | Philadelphia, Pa. | 200 | 50 |
| WPTF | Raleigh, N. C. | 441 | 1000 |
| WQAM | Miami, Fla. | 242 | 1000 |
| WQAO | See WPAP | | |
| WQBC | Utica, Miss. | 220 | 300 |
| WQBZ | Weirton, W. Va. | 211 | 60 |
| WRAF | LaPorte, Ind. | 250 | 100 |
| WRAK | Erie, Pa. | 219 | 50 |
| WRAW | Reading, Pa. | 229 | 100 |
| WRAX | Philadelphia, Pa. (day) | 246 | 250 |
| WRBC | Valparaiso, Ind. (day) | 242 | 500 |
| WRBI | Tifton, Ga. | 229 | 20 |
| WRBJ | Hattiesburg, Miss. | 200 | 10 |
| WRBL | Columbus, Ga. | 250 | 50 |
| WRBQ | Greenville, Miss. | 248 | 100 |
| WRBT | Wilmington, N. C. | 219 | 100 |
| WRBU | Gastonia, N. C. | 248 | 100 |
| WRC | Washington, D. C. | 316 | 500 |
| WREC | Memphis, Tenn. | 500 | 500 |
| WREN | Lawrence, Kansas. | 246 | 1000 |
| WRHM | Minneapolis, Minn. | 240 | 1000 |
| WRJN | Racine, Wis. | 219 | 100 |
| WRK | Hamilton, Ohio. | 229 | 100 |
| WRNY | New York City. | 297 | 250 |
| WRR | Dallas, Texas. | 234 | 500 |
| WRUF | Gainesville, Fla. | 204 | 5000 |
| WRVA | Richmond, Va. | 270 | 1000 |
| WSAI | Cincinnati, Ohio (Ltd.) | 226 | 500 |
| WSAJ | Grove City, Pa. | 229 | 100 |
| WSAN | Allentown, Pa. | 208 | 250 |
| WSAR | Portsmouth, R. I. | 207 | 250 |
| WSAZ | Huntington, W. Va. | 517 | 250 |
| WSB | Atlanta, Ga. | 405 | 1000 |
| WSBT | South Bend, Ind. | 244 | 500 |
| WSDA | Brooklyn, N. Y. | 214 | 500 |
| WSGH | See WSDA | | |
| WSIX | Springfield, Tenn. | 248 | 100 |
| WSM | Nashville, Tenn. | 461 | 5000 |
| WSMB | New Orleans, La. | 227 | 500 |
| WSMK | Dayton, Ohio. | 526 | 200 |
| WSOA | Deerfield, Ill | 203 | 5000 |
| WSPD | Toledo, Ohio. | 224 | 500 |
| WSSH | Boston, Mass. | 211 | 100 |
| WSUI | Iowa City, Iowa. | 517 | 500 |
| WSUN | St. Petersburg, Fla. | 333 | 1000 |
| WSVS | Buffalo, N. Y. | 219 | 50 |
| WSYR | Syracuse, N. Y. | 526 | 250 |
| WTAD | Quincy, Ill. | 208 | 500 |
| WTAG | Worcester, Mass. | 517 | 250 |
| WTAM | Cleveland, Ohio. | 280 | 3500 |
| WTAQ | Washington, Wis. | 225 | 1000 |
| WTAR | Norfolk, Va. | 384 | 500 |
| WTAW | College Station, Texas. | 268 | 500 |
| WTAX | Streator, Ill. | 248 | 50 |
| WTBO | Cumberland, Md. | 211 | 50 |
| WTFI | Toccoa Falls, Ga. | 207 | 250 |
| WTIC | Hartford, Conn. | 500 | 250 |
| WTMJ | Milwaukee, Wis. | 484 | 1000 |
| WWAE | Hammond, Ind | 250 | 100 |
| WWJ | Detroit, Mich. | 326 | 1000 |
| WWL | New Orleans, La. | 353 | 5000 |
| WWNC | Asheville, N. C. | 526 | 1000 |
| WWRL | Woodside, N. Y. | 200 | 100 |
| WWVA | Wheeling, W. Va. | 258 | 250 |

## LIST OF CANADIAN BROADCAST CALLS

| | | | |
|---|---|---|---|
| CFAC | Calgary, Alta. | 434 | 500 |
| CFBO | St. Johns, N. B. | 337 | 50 |
| CFCA | Toronto, Ont. | 357 | 500 |
| CFCF | Montreal, Que. | 291 | 1650 |
| CFCH | Iroquois Falls, Ont. | 500 | 250 |
| CFCL | See CKLC | | |
| CFCN | Calgary, Alta. | 434 | 1800 |
| CFCO | Chatham, Ont. | 248 | 25 |
| CFCT | Victoria, B. C. | 476 | 500 |
| CFCY | Charlottetown, P. E. I. | 312 | 100 |
| CFJC | Kamloops, B. C. | 268 | 15 |
| CFLC | Prescott, Ontario. | 297 | 50 |
| CFNB | Fredericton, N. B. | 248 | 50 |
| CFQC | Saskatoon, Sask. | 329 | 500 |
| CFRB | Toronto, Ont. | 312 | 1000 |
| CFRC | Kingston, Ont. | 268 | 500 |
| CHCA | See CJCJ | | |
| CHCK | Charlottetown, P. E. I. | 312 | 30 |
| CHCS | Hamilton, Ont. | 341 | 10 |
| CHCT | See CKCL | | |
| CHGS | Summerside, P. E. I. | 268 | 25 |
| CHLS | See CKCD | | |
| CHMA | Edmonton, Alta. | 517 | 250 |
| CHML | Mount Hamilton, Ont. | 341 | 50 |
| CHNC | See CKNC | | |
| CHNS | Halifax, N. S. | 322 | 500 |
| CHRC | Quebec, Quebec | 500 | 25 |
| CHWC | Regina, Sask. | 312 | 500 |
| CHWK | Chilliwack, B. C. | 248 | 5 |
| CHYC | Montreal, Que. | 411 | 750 |
| CJBC | (Uses several Toronto stations) | 517, 357 or 312 | |
| CJBR | See CKCK | | |
| CJCA | Edmonton, Alta. | 517 | 500 |
| CJCB | Sydney, Nova Scotia. | 384 | 50 |
| CJCJ | Calgary, Alta. | 434 | 250 |
| CJGC | London, Ont. | 329 | 500 |
| CJGX | Yorkton, Sask. | 476 | 500 |
| CJHS | Saskatoon, Sask. | 329 | 250 |
| CJOC | Lethbridge, Alta. | 268 | 50 |
| CJOR | Sea Island, B. C. | 291 | 50 |
| CJRM | Moose Jaw, Sask. | 500 | 500 |
| CJRW | Fleming, Sask. | 500 | 500 |
| CJSC | See CKCL | | |
| CKAC | Montreal, Que. | 411 | 1200 |
| CKCD | Vancouver, B. C. | 411 | 50 |
| CKCI | Quebec, Que. | 500 | 23 |
| CKCK | Regina, Sask. | 312 | 500 |
| CKCL | Toronto, Ont. | 517 | 500 |
| CKCO | Ottawa, Ont. | 434 | 100 |
| CKCR | Brantford, Ont. | 297 | 50 |
| CKCV | Quebec, Que. | 500 | 50 |
| CKFC | Vancouver, B. C. | 411 | 50 |
| CKGW | Bowmanville, Ont. | 312 | 5000 |
| CKLC | Red Deer, Alberta. | 357 | 1000 |
| CKMC | Cobalt, Ont. | 248 | 15 |
| CKMO | Vancouver, B. C. | 411 | 50 |
| CKNC | Toronto, Ont. | 517 | 500 |
| CKOC | Hamilton, Ont. | 341 | 100 |
| CKOW | See CFCA | | |
| CKPC | Preston, Ont. | 248 | 25 |
| CKPR | Midland, Ont. | 268 | 50 |
| CKSH | St. Hyacinthe, Que. | 297 | 50 |
| CKUA | Edmonton, Alta. | 517 | 500 |
| CKWX | Vancouver, B. C. | 411 | 100 |
| CKX | Brandon, Man. | 556 | 500 |
| CKY | Winnipeg, Man. | 384 | 5000 |
| CNRA | Moncton, N. B. | 476 | 500 |
| CNRC | See CFAC | | |
| CNRE | See CJCA | | |
| CNRM | See CHYC, CKAC, or CFCF | | |
| CNRO | Ottawa, Ont. | 434 | 500 |
| CNRQ | See CKCV | | |
| CNRR | See CKCK | | |
| CNRS | See CFQC | | |
| CNRT | See CFCA | | |
| CNRV | Vancouver, B. C. | 291 | 500 |
| CNRW | See CKY | | |
| VAS | Louisburg, Nova Scotia. | 434 | |

| Wave (Meters) | Radio Call Letters | BROADCAST STA. Location | Power (Watts) |
|---|---|---|---|
| 545,1 | KFDY | Brookings, S. D. | 500 |
| | KFUO | Clayton, Mo. | 500 |
| | KFYR | Bismarck, N. D. | 500 |
| | KSD | St. Louis, Mo. | 500 |
| | KTAB | Oakland, Calif. | 500 |
| | WEAN | Providence, R. I. | 250 |
| | WEAO | Columbus, Ohio. | 750 |
| | WGR | Buffalo, N. Y. | 1000 |
| | WKRC | Cincinnati, Ohio. | 500 |
| 535,4 | KFDM | Beaumont, Texas. | 500 |
| | KFEQ | St. Joseph, Mo. (day) | 2500 |
| | KLZ | Dupont, Colo. | 1000 |
| | KOAC | Corvallis, Oregon. | 1000 |
| | WFI | Philadelphia, Pa. | 500 |
| | WIOD | Miama, Fla. | 1000 |
| | WLIT | Philadelphia, Pa. | 500 |
| | WNOX | Knoxville, Tenn. | 1000 |
| | WOI | Ames, Iowa (day). | 3500 |
| 526, | KGKO | Wichita Falls, Texas. | 250 |
| | KMTR | Hollywood, Calif. | 500 |
| | KUOM | Missoula, Montana. | 500 |
| | KXA | Seattle, Wash. | 500 |
| | WIBO | Chicago, Ill. | 1000 |
| | WKBN | Youngstown, Ohio. | 500 |
| | WMAC | Cazenovia, N. Y. | 250 |
| | WMC | Memphis, Tenn. | 500 |
| | WMCA | New York, N. Y. | 500 |
| | WNAX | Yankton, S. D. | 1000 |
| | WNYC | New York, N. Y. | 500 |
| | WPCC | Chicago, Ill. | 500 |
| | WSMK | Dayton, Ohio. | 200 |
| | WSYR | Syracuse, N. Y. | 250 |
| | WWNC | Asheville, N. C. | 1000 |
| 516,9 | KGFX | Pierre, S. D. (day) | 200 |
| | KSAC | Manhattan, Kansas. | 500 |
| | WOBU | Charleston, W. Va. | 250 |
| | WSAZ | Huntington, W. Va. | 250 |
| | WSUI | Iowa City, Iowa. | 500 |
| | WTAG | Worcester, Mass. | 250 |
| 508,2 | KHQ | Spokane, Wash. | 1000 |
| | WCAJ | Lincoln, Neb. | 500 |
| | WEEI | Boston, Mass. | 500 |
| | WEMC | Berrien Springs, Mich. | 1000 |
| | WOW | Omaha, Neb. | 1000 |
| 499,7 | KFSD | San Diego, Cal. | 500 |
| | KWYO | Laramie, Wyo. | 500 |
| | WCAC | Storrs, Conn. | 250 |
| | WCAO | Baltimore, Md. | 250 |
| | WEBW | Beloit, Wis. | 350 |
| | WOAN | Lawrenceburg, Tenn. | 500 |
| | WREC | Memphis, Tenn. | 500 |
| 491,5 | KFRC | San Francisco, Calif. | 1000 |
| | WDAF | Kansas City, Mo. | 1000 |
| | WFAN | Philadelphia, Pa. | 500 |
| | WIP | Philadelphia, Pa. | 500 |
| | WOQ | Kansas City, Mo. | 1000 |
| 483,6 | KFAD | Phoenix, Ariz. | 500 |
| | KGW | Portland, Oregon. | 1000 |
| | WDAE | Tampa, Fla. | 1000 |
| | WDBO | Orlando, Fla. | 1000 |
| | WLBZ | Bangor, Me. | 250 |
| | WTMJ | Milwaukee, Wis. | 1000 |
| 475,9 | KFRU | Columbia, Mo. | 500 |
| | WGBF | Evansville, Ind. | 500 |
| | WMAL | Washington, D. C. | 250 |
| | WOS | Jefferson City, Mo. | 500 |
| 468,5 | KFI | Los Angeles, Calif. | 5000 |
| | WAIU | Columbus, Ohio. | 500 |
| 461,3 | WSM | Nashville, Tenn. | 5000 |
| 454,3 | WAAW | Omaha, Neb. | 500 |
| | WBAF | New York, N. Y. | 50000 |
| 447,5 | WMAQ | Chicago, Ill. | 5000 |
| 440,9 | KPO | San Francisco, Calif. | 5000 |
| | WPTF | Raleigh, N. C. | 1000 |
| 434,5 | NAA | Arlington, Va. | 1000 |
| | KFVD | Venice, Calif. | 250 |
| | WLW | Cincinnati, Ohio. | 50000 |
| | KTM | Santa Monica, Cal. | 500 |
| 422,3 | WOR | Newark, N. J. | 5000 |
| | KFVD | Culver City, Cal. | 250 |
| 416,4 | WGN | Chicago, Ill. | 25000 |
| | WLIB | Chicago, Ill. | 25000 |
| 405,2 | KMMJ | Clay Center ,Neb. (day) | 1000 |
| | WSB | Atlanta, Ga. | 1000 |
| | WJR | Pontiac, Mich. | 5000 |
| 394,5 | KVI | Des Moines, Wash. | 1000 |
| | WEW | St. Louis, Mo. (day) | 1000 |
| | WJZ | New York, N. Y. | 30000 |
| 389,4 | KFAB | Lincoln, Neb. | 5000 |
| | WBBM | Chicago, Ill. | 10000 |
| | WJBT | Chicago, Ill. | 25000 |
| 384,4 | KELW | Burbank, Calif. | 500 |
| | WBSO | Wellesley Hills, Mass. | 250 |
| | WPOR | Norfolk, Va. | 500 |
| | WTAR | Norfolk, Va. | 500 |
| 379,5 | KGO | Oakland, Calif. | 7500 |
| | WGY | Schenectady, N. Y. | 50000 |
| 374,8 | WBAP | Fort Worth, Texas. | 50000 |
| | WFAA | Dallas, Texas. | 500 |
| 370,2 | WCCO | Minn., St. Paul, Minn. | 15000 |
| | WPCH | New York, N. Y. | 500 |
| 365,6 | WHAS | Louisville, Ky. | 5000 |
| 361,2 | KOA | Denver, Colo. | 13500 |
| | WHOH | Gloucester, Mass. | 500 |
| 352,7 | KWKH | Kennonwood, La. | 20000 |
| | WWL | Gloucester, Mass. | 5000 |
| 348,6 | KFQZ | Hollywood, Calif. | 250 |
| | WABC | New York City, N. Y. | 5000 |
| | WBOQ | New York City, N. Y. | 5000 |
| 344,6 | WBCN | Chicago, Ill. | 25000 |
| | WENR | Chicago, Ill. | 25000 |
| | WLS | Chicago, Ill. | 5000 |
| 340,7 | KFKA | Greeley, Colo. | 500 |
| | KLX | Oakland, Calif. | 500 |
| | KPOF | Denver, Colo. | 500 |
| | WCOC | Columbus, Miss. | 500 |
| | WGBI | Scranton, Pa. | 250 |
| 336,9 | KFNF | Shenandoah, Iowa. | 500 |
| | KGJF | Little Rock, Ark. | 250 |
| | KUSD | Vermillion, S. D. | 500 |
| | WGST | Atlanta, Ga. | 250 |
| | WILL | Urbana, Ill. | 250 |
| | WJAR | Providence, R. I. | 250 |
| | WMAZ | Macon, Ga. | 250 |
| | WMMN | Fairmont, W. Va. | 250 |
| 333,1 | KHJ | Los Angeles, Calif. | 1000 |
| | KSEI | Pocatello, Idaho. | 250 |
| | WFBL | Syracuse, N. Y. | 750 |
| | WFLA | Clearwater, Fla. | 1000 |
| | WKY | Oklahoma City, Okla. | 1000 |
| | WLBL | Stevens Point, Wis. (day) | 2000 |
| | WMAK | Buffalo, N. Y. | 750 |
| | WSUN | Clearwater, Fla. | 1000 |
| 325,9 | KOMO | Seattle, Wash. | 1000 |
| | KPRC | Houston, Texas. | 1000 |
| | WAAF | Chicago, Ill. (day) | 500 |
| | WWJ | Detroit, Mich. | 1000 |
| 322,4 | KFWI | San Francisco, Calif. | 500 |
| | KFWM | Oakland, Calif. | 500 |
| | KMA | Shenandoah, Iowa. | 500 |
| | WBRC | Birmingham, Ala. | 500 |
| | WDBJ | Roanoke, Va. | 250 |
| | WIBG | Elkins Park, Pa. (Sunday) | 50 |
| 319, | KFEL | Denver, Colo. | 250 |
| | KFXF | Denver, Colo. | 250 |
| | KOIN | Portland, Oregon. | 1000 |
| | WCHS | Portland, Maine. | 500 |
| | WFIW | Hopkinsville, Ky. | 1000 |
| | WHA | Madison, Wis. | 750 |
| 315,6 | KFWB | Hollywood. Calif. | 1000 |
| | KGHL | Billings, Mont. | 500 |
| | KMBC | Independence, Mo. | 1000 |
| | KPSN | Pasadena, Calif. | 1000 |
| | WRC | Washington, D. C. | 500 |
| 309,1 | KJR | Seattle, Wash. | 5000 |
| | WCFL | Chicago, Ill. | 1500 |
| 305,9 | KDKA | Pittsburgh, Pa. | 50000 |
| 302,8 | WBZ | Springfield, Mass. | 15000 |
| | WBZA | Boston, Mass. | 500 |
| 299,8 | KPLA | Los Angeles, Calif. | 1000 |
| | WHO | Des Moines, Iowa. | 5000 |
| | WOC | Davenport, Iowa. | 5000 |
| 296,9 | KGCF | Picher, Okla. | 500 |
| | KOW | San Jose, Calif. | 500 |
| | WHN | New York, N. Y. | 500 |
| | WNAD | Norman, Okla. | 250 |
| | WPAP | Palisade, N. J. | 250 |
| | WQAO | Cliffside, N. J. | 250 |
| | WRNY | New York, N. Y. | 250 |

**THIS list of stations in the United States operating under licenses issued by the Federal Radio Commission is corrected to April 30, 1929. Powers shown are the night strength, or minimum.**

| Wave (Meters) | Radio Call Letters | BROADCAST STA. Location | Power (Watts) |
|---|---|---|---|
| 293,9 | KFKX | Chicago, Ill. | 5000 |
| | KYW | Chicago, Ill. | 5000 |
| | KYWA | Chicago, Ill. | 500 |
| | WRAX | Philadelphia, Pa. (day) | 250 |
| 288,3 | KRLD | Dallas, Texas. | 10000 |
| | KTHS | Hot Springs Nat'l Park, Ark. | 1000 |
| | WKAR | East Lansing, Mich. (day) | 500 |
| | WFAA | Dallas, Texas. | 500 |
| | WKEN | Buffalo, N. Y. | 1000 |
| 285,5 | KNX | Los Angeles, Calif. | 5000 |
| 282,8 | KWJJ | Portland, Oregon. | 500 |
| | WBAL | Baltimore, Md. | 10000 |
| | WJAG | Norfolk, Neb. (day) | 500 |
| | WTIC | Hartford, Conn. | 50000 |
| 280,2 | WAAT | Jersey City, N. J. (day) | 300 |
| | WCAZ | Carthage, Ill. (day) | 50 |
| | WDZ | Tuscola, Ill. | 100 |
| | WEAR | Cleveland, Ohio. | 1000 |
| | WTAM | Cleveland, Ohio. | 3500 |
| 277,6 | WBT | Charlotte, N. C. | 5000 |
| | WCBD | Zion, Ill. (day) | 5000 |
| | WMBI | Addison, Ill. (day) | 5000 |
| 275,1 | KFQA | St. Louis, Mo. | 5000 |
| | KMOX | St. Louis, Mo. | 5000 |
| 272,6 | KGBS | San Francisco, Calif. (day) | 100 |
| | WLWL | New York City, N. Y. | 5000 |
| | WPG | Atlantic City, N. J. | 5000 |
| 270,1 | KSOO | Sioux Falls, S. D. (day) | 2000 |
| | WRVA | Richmond, Va. | 1000 |
| 267,7 | KFSG | Los Angeles, Calif. | 500 |
| | KMIC | Inglewood, Calif. | 500 |
| | KRSC | Seattle, Wash. (day) | 50 |
| | KUT | Austin, Texas | 500 |
| | WCOA | Pensacola, Fla. | 500 |
| | WDEL | Wilmington, Del. | 250 |
| | WHAD | Milwaukee, Wis. (day) | 250 |
| | WISN | Milwaukee, Wis. | 250 |
| | WTAW | College Station, Texas | 500 |
| 265,3 | KFKB | Milford, Kansas (day) | 5000 |
| | KSL | Salt Lake City, Utah | 5000 |
| | WOV | New York, N. Y. (day) | 1000 |
| 263 | KVOO | Tulsa, Okla. | 5000 |
| | WAPI | Auburn, Ala. | 5000 |
| 260.7 | KGDM | Stockton, Calif. (day) | 50 |
| | WHAM | Rochester, N. Y. | 5000 |
| 258.5 | WOWO | Fort Wayne, Ind. | 1000 |
| | WWVA | Wheeling, W. Va. | 250 |
| 256.3 | KTNT | Muscatine, Iowa (day) | 5000 |
| | WCAU | Philadelphia, Pa. | 10000 |
| 254.1 | KEX | Portland, Oregon. | 5000 |
| | KOB | State College, N. Mex. | 10000 |
| | WGBS | New York, N. Y. | 500 |
| | WHDI | Minneapolis, Minn. | 1500 |
| | WJJD | Mooseheart, Ill. | 20000 |
| 252 | WICC | Bridgeport, Conn. (day) | 500 |
| | WOAI | San Antonio, Texas. | 5000 |
| | WRR | Dallas, Texas. | 5000 |
| 249.9 | KFHA | Gunnison, Colo. | 50 |
| | KFJB | Marshalltown, Iowa. | 100 |
| | KFKZ | Kirksville, Mo. | 15 |
| | KFWC | Ontario, Calif. | 100 |
| | KFWF | St. Louis, Mo. | 100 |
| | KGCU | Mandan, N. D. | 100 |
| | KGDE | Fergus Falls, Minn. | 50 |
| | KGDY | Oldham, S. D. | 15 |
| | KGEK | Yuma, Colo. | 50 |
| | KGEW | Fort Morgan, Colo. | 100 |
| | KGFK | Hallock, Minn. | 50 |
| | KGY | Lacey, Wash. | 10 |
| | KMJ | Fresno, Calif. | 100 |
| | KOX | El Centro, Calif. | 15 |
| | KPPC | Pasadena, Calif. | 50 |
| | KSMR | Santa Maria, Calif. | 100 |
| | KVOS | Bellingham, Wash. | 100 |
| | WABI | Bangor, Maine. | 100 |
| | WABZ | New Orleans, La. | 100 |
| | WBBW | Norfolk, Va. | 100 |
| | WBBY | Charleston, S. C. | 75 |
| | WBBZ | Ponca City, Okla. | 100 |
| | WCAT | Rapid City, S. D. | 100 |
| | WCLO | Kenosha, Wis. | 100 |
| | WEPS | Gloucester, Mass. | 100 |
| | WFBC | Knoxville, Tenn. | 50 |
| | WHBC | Canton, Ohio. | 10 |
| | WHBY | West De Pere, Wis. | 50 |
| | WIBX | Utica, N. Y. | 100 |
| | WIL | St. Louis, Mo. | 100 |
| | WJBC | La Salle, Ill. | 100 |
| | WJBL | Decatur, Ill. | 100 |
| | WJBW | New Orleans, La. | 30 |
| | WKBE | Webster, Mass. | 100 |
| | WKJC | Lancaster, Pa. | 100 |
| | WLAP | Louisville, Ky. | 30 |
| | WLBG | Ettrick, Va. | 100 |
| | WMAY | St. Louis, La. | 100 |
| | WMT | Cedar Rapids, Iowa. | 100 |
| | WNBO | Washington, Pa. | 100 |
| | WNBW | Carbondale, Pa. | 5 |
| | WNBX | Springfield, Vt. | 10 |
| | WCOD | Harrisburg, Pa. | 100 |
| | WQBJ | Clarksburg, W. Va. | 65 |
| | WRAF | Laporte, Ind. | 100 |
| | WRBL | Columbus, Ga. | 50 |
| | WRJN | Racine, Wis. | 100 |
| | WWAE | Hammond, Ind. | 100 |
| 247.8 | KDLR | Devils Lake, N. D. | 100 |
| | KFOR | Lincoln, Neb. | 100 |
| | KFVS | Cape Girardeau, Mo. | 100 |
| | KGCR | Brookings, S. D. | 100 |
| | KPCB | Seattle, Wash. | 100 |
| | KPQ | Seattle, Wash. | 100 |
| | KWEA | Shreveport, La. | 100 |
| | WBAX | Wilkes-Barre, Pa. | 100 |
| | WCBS | Springfield, Ill. | 100 |
| | WCOH | Greenville, N. Y. | 100 |
| | WCRW | Chicago, Ill. | 100 |
| | WDWF | Cranston, R. I. | 100 |
| | WEBE | Cambridge, Ohio. | 100 |
| | WEBQ | Harrisburg, Ill. | 100 |
| | WEDC | Chicago, Ill. | 100 |
| | WGBB | Freeport, N. Y. | 100 |
| | WGCM | Gulfport, Miss. | 100 |
| | WHBF | Rock Island, Ill. | 100 |
| | WHBU | Anderson, Ind. | 100 |
| | WIBA | Madison, Wis. | 100 |
| | WINR | Bay Shore, N. Y. | 100 |
| | WJBI | Red Bank, N. J. | 100 |
| | WJBU | Lewisburg, Pa. | 100 |
| | WJBY | Gadsden, Ala. | 50 |
| | WJW | Mansfield, Ohio. | 100 |
| | WLCI | Ithaca, N. Y. | 50 |
| | WLSI | Cranston, R. I. | 100 |
| | WMAN | Columbus, Ohio. | 50 |
| | WMBG | Richmond, Va. | 100 |
| | WMBR | Tampa, Fla. | 100 |
| | WOCL | Jamestown, N. Y. | 25 |
| | WOMT | Manitowoc, Wis. | 100 |
| | WPAW | Pawtucket, R. I. | 100 |
| | WRBQ | Greenville, Miss. | 100 |
| | WRBU | Gastonia, N. C. | 100 |
| | WSIX | Springfield, Tenn. | 100 |
| | WTAZ | Richmond, Va. | 150 |
| 245.8 | KFKU | Lawrence, Kansas. | 1000 |
| | WCAE | Pittsburgh, Pa. | 500 |
| | WCAD | Canton, N. Y. (day) | 500 |
| | WREN | Lawrence, Kansas. | 1000 |
| 243.8 | KFIO | Spokane, Wash. (day) | 100 |
| | KYA | San Francisco, Calif. | 1000 |
| | WBIS | Quincy, Mass. | 500 |
| | WFBM | Indianapolis, Ind. | 1000 |
| | WNAC | Boston, Mass. | 500 |
| | WPSC | State College, Pa. (day) | 500 |
| | WSBT | South Bend, Ind. | 500 |
| 241.8 | KTAT | Fort Worth, Texas. | 1000 |
| | WGHP | Fraser, Mich. | 750 |
| | WJAD | Waco, Texas. | 1000 |
| | WQAM | Miami, Fla. | 750 |
| | WRBC | Valparaiso, Ind. (day) | 500 |
| 239.9 | KEJK | Los Angeles, Calif. | 500 |
| | KFMX | Northfield, Minn. | 1000 |
| | KFOX | Long Beach, Calif. | 1000 |
| | KIDO | Boise, Idaho. | 1000 |
| | KXL | Portland, Oregon. | 500 |
| | WAAM | Newark, N. J. | 500 |
| | WCAL | Northfield, Minn. | 1000 |
| | WGCP | Newark, N. J. | 250 |
| | WGMS | St. Paul-Minn., Minn. | 1000 |
| | WLB | Minneapolis, Minn. | 500 |
| | WODA | Paterson, N. J. | 1000 |
| | WRHM | Minneapolis, Minn. | 1000 |
| 238 | KOIL | Council Bluffs, Iowa. | 1000 |
| | KRGV | Harlingden, Texas. | 500 |
| | KWWG | Brownsville, Texas. | 500 |
| | WJAX | Jacksonville, Fla. | 1000 |
| | WLBW | Oil City, Pa. | 500 |
| 236.1 | KFUM | Colorado Springs, Colo. | 1000 |
| | KGCA | Decorah, Iowa (day) | 50 |
| | KOL | Seattle, Wash. | 1000 |
| | KTW | Seattle, Wash. | 1000 |
| | KWLC | Decorah, Iowa (day) | 100 |
| | WASH | Grand Rapids, Mich. | 250 |
| | WDSU | New Orleans, La. | 1000 |
| | WEAI | Ithaca, N. Y. (day) | 500 |
| | WFBR | Baltimore, Md. | 250 |
| | WOL | Washington, D. C. (day) | 150 |
| | WOOD | Grand Rapids, Mich. | 500 |
| 234.2 | WCAM | Camden, N. J. | 500 |
| | WCAP | Asbury Park, N. J. | 500 |
| | WDAY | West Fargo, N. D. | 1000 |
| | WDOD | Chattanooga, Tenn. | 500 |
| | WEBC | Superior, Wis. | 1000 |
| | WOAX | Trenton, N. J. | 500 |
| | WRR | Dallas, Texas. | 500 |
| 232.4 | KDYL | Salt Lake City, Utah. | 1000 |
| | KFUL | Galveston, Texas. | 1000 |
| | KLCN | Blytheville, Ark. (day) | 50 |
| | KTSA | San Antonio, Texas. | 1000 |
| | WJAS | Pittsburgh, Pa. | 1000 |
| | WNBZ | Saranac Lake, N. Y. (day) | 50 |
| 230.6 | KFH | Wichita, Kansas. | 500 |
| | KFJR | Portland, Oregon. | 500 |
| | KGEF | Los Angeles, Calif. | 1000 |
| | KTBI | Los Angeles, Calif. | 750 |
| | KTBR | Portland, Oregon. | 500 |
| | WBBR | Rossville, N. Y. | 1000 |
| | WEVD | New York, N. Y. | 500 |
| | WHAP | New York, N. Y. | 1000 |
| | WHAZ | Troy, N. Y. | 500 |
| | WIBW | Topeka, Kansas. | 1000 |
| 228.9 | KFBK | Sacramento, Calif. | 100 |
| | KFGQ | Boone, Iowa. | 100 |
| | KFJY | Fort Dodge, Iowa. | 100 |
| | KFPL | Dublin, Texas. | 15 |
| | KFPM | Greenville, Texas. | 15 |
| | KFUP | Denver, Colo. | 100 |
| | KFXJ | Edgewater, Colo. | 50 |
| | KFXR | Oklahoma City, Okla. | 100 |
| | KGBZ | Kalispell, Mont. | 100 |
| | KGHG | McGehee, Ark. | 50 |
| | KMED | Medford, Oregon. | 50 |
| | KRMD | Shreveport, La. | 50 |
| | KTSL | Shreveport, La. | 50 |
| | KWCR | Cedar Rapids, Iowa. | 100 |
| | WAGM | Royal Oak, Mich. | 50 |
| | WBMH | Detroit, Mich. | 100 |
| | WBOW | Terre Haute, Ind. | 100 |
| | WBRE | Wilkes-Barre, Pa. | 100 |
| | WCLS | Joliet, Ill. | 100 |
| | WDAH | El Paso, Texas. | 100 |
| | WEBR | Buffalo, N. Y. | 100 |
| | WEHS | Evanston, Ill. | 100 |

| Wave (Meters) | Radio Call Letters | BROADCASTING STA. Location | Power (Watts) |
|---|---|---|---|
| | WFBG | Altoona, Pa. | 100 |
| | WFDF | Flint, Mich. | 100 |
| | WFKD | Philadelphia, Pa. | 50 |
| | WGAL | Lancaster, Pa. | 15 |
| | WGH | Newport News, Va. | 100 |
| | WHBP | Johnstown, Pa. | 100 |
| | WHFC | Cicero, Ill. | 100 |
| | WIBU | Poynette, Wis. | 100 |
| | WJAK | Kokomo, Ind. | 50 |
| | WKAV | Laconia, N. H. | 50 |
| | WKBB | Joliet, Ill. | 100 |
| | WKBC | Birmingham, Ala. | 10 |
| | WKBI | Chicago, Ill. | 50 |
| | WKBS | Galesburg, Ill. | 100 |
| | WLBC | Muncie, Ind. | 50 |
| | WMBL | Lakeland, Fla. | 100 |
| | WNAT | Philadelphia, Pa. | 100 |
| | WNBH | New Bedford, Mass. | 100 |
| | WNBJ | Knoxville, Tenn. | 50 |
| | WOBT | Union City, Tenn. | 15 |
| | WRAW | Reading, Pa. | 100 |
| | WRBI | Tifton, Ga. | 20 |
| | WRK | Hamilton, Ohio. | 100 |
| | WSAJ | Grove City, Pa. | 100 |
| 227.1 | KID | Idaho Falls, Idaho. | 250 |
| | KGHF | Pueblo, Colo. | 250 |
| | KGIQ | Twin Falls, Idaho. | 250 |
| | WADC | Akron, Ohio. | 1000 |
| | WSMB | New Orleans, La. | 500 |
| 225.4 | KSCJ | Sioux City, Iowa. | 1000 |
| | WDRC | New Haven, Conn. | 500 |
| | WSAI | Cincinnati, Ohio. | 500 |
| | WTAQ | Tnshp. of Wash., Wis. | 1000 |
| 223.7 | KFPW | Sulphur Sp'gs., Ark (day)i. | 50 |
| | KMO | Tacoma, Wash. | 500 |
| | KVI | Des Moines, Wash. | 1000 |
| | WSPD | Toledo, Ohio. | 500 |
| 222.1 | KWK | St. Louis, Mo. | 1000 |
| | WBNY | New York, N. Y. | 250 |
| | WCDA | New York, N. Y. | 250 |
| | WKBQ | New York, N. Y. | 250 |
| | WMSG | New York, N. Y. | 250 |
| 220.4 | KFBB | Harve, Mont. | 250 |
| | KGB | San Diego, Calif. | 250 |
| | KGIR | Butte, Mont. | 250 |
| | WGES | Chicago, Ill. | 500 |
| | WJKS | Gary, Ind. | 500 |
| | WLEX | Boston, Mass. | 500 |
| | WMAF | South Dartmouth, Mass. | 500 |
| | WQBC | Utica, Miss. | 300 |
| 218.8 | KCRC | Enid, Okla. | 100 |
| | KFBL | Everett, Wash. | 50 |
| | KFJI | Astoria, Oregon. | 50 |
| | KFJM | Grand Forks, N. D. | 100 |
| | KFJX | Fort Worth, Texas. | 100 |
| | KFLX | Galveston, Texas. | 100 |
| | KGAR | Tucson, Arizona. | 100 |
| | KGBX | St. Joseph, Mo. | 100 |
| | KGCI | San Antonio, Texas. | 100 |
| | KGDA | Dell Rapids, S. D. | 50 |
| | KGER | Long Beach, Calif. | 100 |
| | KGFG | Oklahoma City, Okla. | 100 |
| | KGFL | Raton, New Mexico. | 50 |
| | KGGM | Albuquerque, N. Mex. | 100 |
| | KGKL | San Angelo, Texas. | 100 |
| | KGRC | San Antonio, Texas. | 100 |
| | KIT | Yakima, Wash. | 50 |
| | KLO | Ogden, Utah. | 100 |
| | KOH | Reno, Nevada. | 100 |
| | KOOS | Marshfield, Oregon. | 50 |
| | KRE | Berkeley, Calif. | 100 |
| | KVL | Seattle, Wash. | 100 |
| | KWKC | Kansas City, Mo. | 100 |
| | KZM | Oakland, Calif. | 100 |
| | WBBL | Richmond, Va. | 100 |
| | WCBM | Baltimore, Md. | 100 |
| | WELK | Philadelphia, Pa. | 100 |
| | WFBJ | Collegeville, Minn. | 100 |
| | WGL | Fort Wayne, Ind. | 100 |
| | WHBD | Bellefontaine, Ohio. | 100 |
| | WHBQ | Memphis, Tenn. | 100 |
| | WHDF | Calumet, Mich. | 100 |
| | WIBM | Jackson, Mich. | 100 |
| | WJBK | Ypsilanti, Mich. | 100 |
| | WJBO | New Orleans, La. | 100 |
| | WMBO | Auburn, N. Y. | 100 |
| | WRAK | Erie, Pa. | 50 |
| | WRBT | Wilmington, N. C. | 50 |
| | WSVS | Buffalo, N. Y. | 50 |
| 217.3 | KQV | Pittsburgh, Pa. | 500 |
| | KSO | Clarinda, Iowa. | 1000 |
| | WCSO | Springfield, Ohio. | 500 |
| | WKBH | LaCrosse, Wis. | 1000 |
| 215.7 | KFPY | Spokane, Wash. | 500 |
| | KLRA | Little Rock, Ark. | 1000 |
| | KOY | Phoenix, Arizona. | 500 |
| | KUOA | Fayetteville, Ark. | 1000 |
| | KWSC | Pullman, Wash. | 500 |
| | WDGY | Minneapolis, Minn. | 500 |
| | WHDI | Minneapolis, Minn. | 500 |
| | WHK | Cleveland, Ohio. | 1000 |
| 214.2 | KPWF | Westminster, Calif. | 10000 |
| | WBBC | Brooklyn, N. Y. | 500 |
| | WCGU | Brooklyn, N. Y. | 500 |
| | WCMA | Culver, Ind. | 500 |
| | WKBF | Indianapolis, Ind. | 500 |
| | WLTH | Brooklyn, N. Y. | 500 |
| | WSDA | Brooklyn, N. Y. | 500 |
| | WSGH | Brooklyn, N. Y. | 500 |
| 212.6 | KFLV | Rockford, Ill. | 500 |
| | KGRS | Amarillo, Texas. | 1000 |
| | WBCM | Hampton Tnshp., Mich. | 500 |
| | WDAG | Amarillo, Texas. | 250 |
| | WHBL | Sheboygan, Wis. | 500 |
| 211.1 | KFIF | Portland, Oregon. | 500 |
| | KFIZ | Fond du Lac, Wis. | 100 |
| | KFQU | Holy City, Calif. | 100 |
| | KFQW | Seattle, Wash. | 100 |
| | KFXD | Jerome, Idaho. | 50 |
| | KFXY | Flagstaff, Arizona. | 100 |
| | KFYO | Abilene, Texas. | 100 |
| | KGCX | Vida, Montana. | 100 |
| | KGFF | Alva, Okla. | 100 |
| | KGFJ | Los Angeles, Calif. | 100 |
| | KGFW | Ravenna, Neb. | 50 |
| | KGGC | San Francisco, Cal. | 50 |
| | KGIW | Trinidad, Colo. | 100 |
| | KGIX | Las Vegas, Nev. | 100 |
| | KGKX | Sandpoint, Idaho. | 10 |
| | KOCW | Chickasha, Okla. | 105 |
| | KORE | Eugene, Oregon. | 100 |
| | KTAP | San Antonio, Texas. | 100 |
| | KTUE | Houston, Texas. | 0 |
| | KVOA | Tucson, Ariz. | 505 |
| | KXRO | Seattle, Wash. | 70 |
| | WEDH | Erie, Pa. | 35 |
| | WHDL | Tupper Lake, N. Y. | 10 |
| | WHIS | Bluefield, W. Va. | 100 |
| | WIAS | Ottumwa, Iowa. | 100 |
| | WIBR | Steubenville, Ohio. | 50 |
| | WILM | Wilmington, Del. | 100 |
| | WKBP | Battle Creek, Mich. | 50 |
| | WLBF | Kansas City, Mo. | 100 |
| | WLEY | Lexington, Mass. | 100 |
| | WMBC | Detroit, Mich. | 100 |
| | WMBH | Joplin, Mo. | 100 |
| | WMRJ | Jamaica, N. Y. | 10 |
| | WPOE | Patchogue, N.Y. | 30 |
| | WQBZ | Weirton, W. Va. | 50 |
| | WSSH | Boston, Mass. | 100 |
| | WTBO | Cumberland, Md. | 50 |
| 209.7 | WBAK | Harrisburg, Pa. (day) | 500 |
| | WBRL | Tilton, N. H. | 500 |
| | WCAH | Columbus, Ohio. | 500 |
| | WGBC | Memphis, Tenn. | 500 |
| | WNBR | Memphis, Tenn. | 500 |
| 208.2 | KLS | Oakland, Calif. (day) | 100 |
| | WABO | Rochester, N. Y. | 500 |
| | WCBA | Allentown, Pa. | 250 |
| | WHEC | Rochester, N. Y. | 500 |
| | WMBD | Peoria, Ill. | 500 |
| | WNRC | Greenboro, N. C. | 250 |
| | WOKO | Mt. Beacon, N. Y. | 500 |
| | WSAN | Allentown, Pa. | 250 |
| | WTAD | Quincy, Ill. | 500 |
| 206.8 | KTBS | Shreveport, La. | 500 |
| | WBMS | Fort Lee, N. J. | 250 |
| | WFJC | Akron, Ohio. | 500 |
| | WIBS | Elizabeth, N. J. | 250 |
| | WJAY | Cleveland, Ohio. | 500 |
| | WKBO | Jersey City, N. J. | 250 |
| | WNJ | Newark, N. J. | 250 |
| | WSAR | Portsmouth, R. I. | 250 |
| | WTFI | Toccoa Falls, Ga. | 250 |
| 205.4 | KSTP | St. Paul, Minn. | 10000 |
| | WJSV | Mt. Vernon Hills, Va. | 10000 |
| 204 | KFJF | Oklahoma City, Okla. | 5000 |
| | KGA | Spokane, Wash. | 5000 |
| | WKBW | Buffalo, N. Y. | 5000 |
| | WRUF | Gainerseville, Fla. | 5000 |
| 202.6 | WJAZ | Chicago, Ill. | 5000 |
| | WCKY | Villa Madonna, Ky. | 5000 |
| | WORD | Chicago, Ill. | 5000 |
| | WSOA | Deerfield, Ill. | 5000 |
| 201.2 | WBAW | Nashville, Tenn. | 5000 |
| | WLAC | Nashville, Tenn. | 5000 |
| 199.9 | KDB | Santa Barbara, Calif. | 100 |
| | KGDR | San Antonio, Calif. | 100 |
| | KGEI | San Angelo, Texas. | 100 |
| | KGHI | Little Rock, Ark. | 100 |
| | KGHX | Richmond, Texas. | 50 |
| | KGKB | Brownwood, Texas. | 100 |
| | KPJM | Prescott, Arizona. | 100 |
| | KUJ | Longview, Wash. | 10 |
| | KWBS | Portland, Oregon. | 15 |
| | KWTC | Santa Ana, Calif. | 100 |
| | WAFD | Detroit, Mich. | 100 |
| | WALK | Willow Grove, Pa. | 50 |
| | WCLB | Long Beach, N. Y. | 100 |
| | WHP | Harrisburg, Pa. | 500 |
| | WKBV | Brookville, Ind. | 100 |
| | WKBZ | Ludington, Mich. | 50 |
| | WLBX | Long Island City, N. Y. | 100 |
| | WLOE | Chelsea, Mass. | 100 |
| | WMBA | Newport, R. I. | 100 |
| | WMBJ | Wilkinsburg, Pa. | 100 |
| | WMBQ | Brooklyn, N. Y. | 100 |
| | WMES | Boston, Mass. | 50 |
| | WMPC | Lapeer, Mich. | 100 |
| | WNBF | Binghamton, N. Y. | 50 |
| | WOPI | Bristol, Tenn. | 100 |
| | WPSW | Philadelphia, Pa. | 50 |
| | WRBJ | Hattiesburg, Miss. | 10 |
| | WWRL | Woodside, N. Y. | 100 |

# List of Canadian Broadcast Calls

*(By Wavelengths)*

| | | | |
|---|---|---|---|
| 556 | CKX | Brandon, Man. | 500 |
| 517 | CHCT | (See CKCL) | |
| | CHMA | Edmonton, Alta. | 250 |
| | CHNC | (See CKNC) | |
| | CJBC | Toronto, Ont. | |
| | CJCA | Edmonton, Alta. | 500 |
| | CJSC | (See CKCL) | |
| | CKCL | Toronto, Ont. | 500 |
| | CKNC | Toronto, Ont. | 500 |
| | CKUA | Edmonton. Alta. | 500 |
| | CNRJ | (See CJCA) | |
| 500 | CFCH | Iroquois Falls, Ont. | 250 |
| | CHRC | Quebec, Que. | 25 |
| | CJRM | Moose Jaw, Sask. | 500 |
| | CJRW | Fleming, Sask. | 500 |
| | CKCI | Quebec, Que. | 23 |
| | CKCV | Quebec, Que. | 50 |
| | CNRO | (See CKCV) | |
| 476 | CFCT | Victoria, B. C. | 500 |
| | CJGX | Yorkton, Sask. | 500 |
| | CNRA | Moncton, N. B. | 500 |
| 434 | CFAC | Calgary, Alta. | 500 |
| | CFCN | Calgary, Alta. | 1800 |
| | CHCA | (See CJCJ) | |
| | CJCJ | Calgary, Alta. | 250 |
| | CKCO | Ottawa, Ont. | 100 |
| | CNRC | (See CFAC) | |
| | CNRO | Ottawa, Ont. | 500 |
| | VAS | Louisburg, N. S. | |
| 411 | CHLS | (See CKCD) | |
| | CHYC | Montreal, Que. | 750 |
| | CKAC | Montreal, Que. | 1200 |
| | CKCD | Vancouver, B. C. | 50 |
| | CKFC | Vancouver, B. C. | 50 |
| | CKMO | Vancouver, B. C. | 50 |
| | CKWX | Vancouver, B. C. | 100 |
| | CNRM | (See CKAC) | |
| 384 | CJCB | Sydney, N. S. | 50 |
| | CKY | Winnipeg, Man. | 5000 |
| 357 | CFCA | Toronto, Ont. | 500 |
| | CFCL | (See CKLC) | |
| | CJBC | Toronto, Ont. | |
| | CKLC | Red Deer, Alberta. | 1000 |
| | CKOW | (See CFCA) | |
| 341 | CHCS | Hamilton, Ont. | 10 |
| | CHML | Mt. Hamilton, Ont. | 50 |
| | CKOC | Hamilton, Ont. | 100 |
| 337 | CFBO | St. Johns, N. B. | 50 |
| 329 | CFQC | Saskatoon, Sask. | 500 |
| | CJGC | London, Ont. | 500 |
| | CJHS | Saskatoon, Sask. | 250 |
| | CNRS | (See CFQC) | |
| 322 | CHNS | Halifax, N. S. | 500 |
| 312 | CFCY | Charlottetown, P. E. I. | 100 |
| | CFRB | Toronto, Ont. | 1000 |
| | CJBR | (See CKCK) | |
| | CHCK | Charlottetown, P. E. I. | 30 |
| | CHWC | Regina, Sask. | 500 |
| | CJBC | Toronto, Ont. | |
| | CKCK | Regina, Sask. | 500 |
| | CKGW | Bowmanville, Ont. | 5000 |
| | CNRR | (See CKCK) | |
| 297 | CFLC | Prescott, Ont. | 50 |
| | CKCR | Brantford, Ont. | 50 |
| | CKSH | St. Hyacinthe, Que. | 50 |
| 291 | CFCF | Montreal, Que. | 1650 |
| | CJOR | Sea Island, B. C. | 50 |
| | CNRM | (See CFCF) | |
| | CNRV | Vancouver, B. C. | 500 |
| 268 | CFRC | Kingston, Ont. | 500 |
| | CFJC | Kamloops, B. C. | 15 |
| | CHGS | Summerside, P. E. I. | 25 |
| | CJOC | Lethbridge, Alta. | 50 |
| | CKPR | Midland, Ont. | 50 |
| 248 | CFCO | Chatham, Ont. | 25 |
| | CFNB | Fredericton, N. B. | 50 |
| | CHWK | Chilliwack, B. C. | 5 |
| | CKMC | Cobalt, Ont. | 15 |
| | CKPC | Preston, Ont. | 25 |

# Short-Wave Stations of the World

*Alphabetically, by Countries and by Call Letters*

| Call Letters | BROADCAST STA. Location | Wave Length | Power (Watts) |
|---|---|---|---|
| | **AFRICA** | | |
| AIN | Casablanca, Morocco | 51.00 | |
| 8KR | Constantine, Tunis | 42.80 | |
| JP | Johannesburg, U.S. Africa | 25.00 | |
| 7LO | Nairobi, Kenya | 33.50 | 2000 |
| | **AUSTRALIA** | | |
| 2BL | Sydney | 32.50 | |
| 2FC | Sydney | 28.50 | |
| 2ME | Sydney | 28.50 | |
| 3AR | Melbourne | 55.00 | |
| 3LO | Melbourne | 31.55 | |
| 6AG | Perth, West Australia | 32.90 | |
| 6WF | Perth | 104.50 | |
| AGAG | Perth | 41.7 | |
| | **AUSTRIA** | | |
| OHK2 | Vienna | 70.00 | |
| EATH | Vienna | 37.00 | |
| | Vienna | 22.20 | |
| | **BELGIUM** | | |
| EB4A2 | Brussels | 42.00 | 300 |
| | **BRITISH GUIANA** | | |
| BZL | Georgetown | 43.80 | 200 |
| | **CANADA** | | |
| CF | Drummondville, Que. | 32.00 | |
| CJRX | Winnipeg, Man. | 25.58 | 2000 |
| VAS | Louisburg, N. S. | 28.00 | |
| | **COSTA RICA** | | |
| NRH | Heredia | 30.30 | 7½ |
| | **DANTZIG** | | |
| EK4ZZZ | Dantzig | 40.00 | |
| | **DENMARK** | | |
| D7MK | Copenhagen | 32.05 | 500 |
| D7RL | Copenhagen, 42.12 and | 84.24 | 250 |
| | **ENGLAND** | | |
| 5SW | Chelmsford | 25.53 | 15000 |
| 2NM | Caterham | 32.50 | |
| GBS | Rugby | 24.40 | |
| | **FINLAND** | | |
| | Helsingfors (Helsinkl) | 31.50 | |
| | **FRANCE** | | |
| F8GC | Paris ("Radio LL") | 61.00 | 500 |
| F8AV | Nogent | 80.00 | 500 |
| Radio Vitus | Paris | 37.00 | 1500 |
| Eiffel Tower | Paris (time signals) | 32.50 | |
| YR | Lyons (' Radio Lyon") | 40.20 | 250 |
| | Agen | 30.75 | |
| YN | Lyons | 58.00 | 3000 |
| | Nancy | 15.50 | 500 |
| FW4 | Ste. Assise | 24.50 | |
| | **GERMANY** | | |
| AFI | Konigswusterhausen | 14.00 | |
| AFL | Hamburg | 70.00 and 52.00 | |
| AFT | Konigswusterhausen | 14.00 | |
| AFU | Konigswusterhausen | 14.00 | |
| AFK | Berlin (Doberitz) | 37.56, 75.36 | |
| HEA | Nauen | 11.00 | |
| AGC | Berlin | 17.20 | |
| AGJ | Nauen | 56.70 | |
| | **GERMANY**—(Continued) | | |
| AGK | Nauen | 11.00 | |
| LA | Langenberg | 43.90 | |
| POF | Nauen | 11.00 | |
| POZ | Nauen | 18.10 | |
| | Stuttgart | 41.00 | |
| | **HOLLAND** | | |
| PCJ | Eindhoven | 31.4 | 30000 |
| PCKK | Kootwijk | 16.00 | |
| PCL | Kootwijk | 18.00 | 32000 |
| PCMM | Ymuiden | 46.50 | |
| PCPP | Kootwijk | 16.50 | |
| PCRR | Kootwijk | 37.00 | |
| PCTT | Kootwijk | 21.00 | |
| PCUU | The Hague | 37.00 | |
| PHI | Eindhoven | 16.88 | |
| PHOBI | Huize | 30.2 | |
| | **ITALY** | | |
| I1AX | Rome | 20.00, 40.00 | 300 |
| IAY | Placenza | 20.00, 45.00 | 50 |

IT IS impossible to obtain a complete and accurate list of the short-wave stations of the world. For this reason, some of the notations here may be incorrect, and we would appreciate receiving any corrections from readers or stations, so that we can keep the list as accurate as possible.

| | | | |
|---|---|---|---|
| | **JAPAN** | | |
| JFAB | TAIPEH, Formosa | 39.50 | |
| JHBB | Ibarakiken (Hirasio) | 37.50 | 2000 |
| JIPP | Tokio | 20.00 | |
| JKZB | Tokio | 20.00 | |
| JOAK | Tokio, 30.00, 60.00 35.00, 70.00 | | 500 |
| IAA | Iwatsuki | 40.00 | |
| | **JAVA** | | |
| PLE, PLF | Bandoeng | 15.74 and 17.00 | |
| | **MEXICO** | | |
| XC51 | Mexico City | 44.00 | |
| | **MOROCCO** | | |
| AIN | Casablanca | 51.00 | |
| | **NORWAY** | | |
| LCHO | Oslo | 33.00 | |
| LGN | Bergen | 31.25, 30.00 | |
| | **U. S. S. R. (RUSSIA)** | | |
| RDRL | Leningrad | 28.50 | |
| RDW | Moscow | 83.00 | |
| RFM | Khabarovsk (Siberia) | 70.20 | 12000 |
| RFN | Moscow | 50 00 | |
| RA19 | Tomsk (Siberia) | 37.00 | |
| | **SPAIN** | | |
| EAM | Madrid | 30.70 | |
| EAR55 | Barcelona | | |
| | **SWEDEN** | | |
| SAS | Karlsborg | 52.50 | |
| SAA | Karlskrona | 44.40 | |
| | Motala | 99 and 41.45 | 1000 |
| SAJ | Karlsborg | 47.00 | |
| SMHA | Stockholm | 41.00 | |
| | **SWITZERLAND** | | |
| EH90C | Berne | 32.00 | |
| EH9XD | Zurich | 85.00 and 32.00 | |
| | **UNITED STATES** | | |
| KDKA (W8XK, (W8XS, | East Pittsburgh, Pa. W8XP-portable | 62.50 42.75 25.24 | 40000 |
| KEJK (W6XAN) | Los Angeles, Calif. | 105.90 | 250 |
| KEWE | Bolinas, Calif. | 14.10 | |
| KFPY (W7XAB) | Spokane, Wash. | 105.90 | 100 |
| KFQU (W6XBH) | Holy City, Calif. | 31.00 | 50 |
| KFQZ (W6XAL) | Hollywood, Calif. | 108.20 | 50 |
| KFVD (W6XBX) | Culver City, Calif. | 105.00 | 50 |
| KFWB (W6XBR) | Los Angeles, Calif. | 105.00 40.00 | 50 |
| KFWO (W6XAD) | Avalon, Calif. | 53.07 | 100 |
| KGER (W6XBV) | Long Beach, Calif. | 48.86 | |
| KGB | San Diego, Calif. | 65.18 | |
| KGDE | Barrett Minn. | 40.00 | 50 |
| KGO (W6XAX, W6XN) | San Francisco, Calif. | 10 to 40 | 10000 |
| KHJ (W6XAU) | Los Angeles, Calif. | 104.10 | 50 |
| KJBS (W6XAR) | San Francisco, Cal. | 61.00 | 50 |
| KJR (W7XC, W7XO) | Seattle, Wash. | 105.20 | 250 |
| KMOX | St. Louis, Mo. | 49.00 | 15 |
| KMTR | Los Angeles, Calif. | 108.20 | 250 |
| KNRC (W6XAF) | Santa Monica, Cal. | 108.20 | 100 |
| KNX (W6XA) | Los Angeles, Calif. | 107.10 | 100 |
| KOIL (W9XU) | Council Bluffs, Iowa | 61.06 | 500 |
| KWE-KEWE | Bolinas, Calif. | 14.10 | |
| KWJJ (W7XAO) | Portland, Oregon. | 53.54 | 100 |
| NAA | Arlington, Va. | 48.99 and 31.39 | |
| WAAM (W2XBA) | Newark, N. J. | 65.18 | 50 |
| WABC (W2XE) | Richmond Hill,N.Y. | 58.50 | 500 |
| WAJ | Rocky Point, N. Y. | 22.48 | |
| WBRL (W1XY) | Tilton, N. H. | 109.00 | 250 |
| WBZ | Springfield, Mass. | 70.00 | |
| WCFL | Chicago, Ill. | 37.24 | |
| WCGU (W2XBH) | Brooklyn, N. Y. | 54.00 | 150 |
| WCSH (W1XAB) | Portland, Maine. | 63.79 | 250 |
| WCX | Pontiac, Mich. | 32.00 | 75 |
| WEAJ | Rocky Point, N. Y. | 22.48 | |
| WEAO (W8XJ) | Columbus, Ohio. | 54.02 | 25 |
| WGY (W2XAF) (W2XAD) | Schenectady, N.Y. Schenectady, N.Y. | 31.48 19.56 5.00 | |
| WHK (W8XF) | Cleveland, Ohio. | 66.04 | 500 |
| WJR-WCX (W8XAO) | Pontiac, Mich. | 32.00 | |
| WIZ | New Brunswick, N. J. | 43.45 | |
| WJZ (W3XAL) | New York, N. Y. | 49.18 to 13.95 | 30000 |
| WLW (W8XAL) | Cincinnati, Ohio. | 52.02 | 250 |
| WNAL (W9XAB) | Omaha, Neb. | 105.00 | 50 |
| WNBT | Elgin, Ill. (Time Sig.) | 35.50 | 500 |
| WND | Ocean Township, N. J. | 46.48 | |
| WOR (W2XAQ) | Kearny, N. J. | 65.40 | 50 |
| WOWO | Fort Wayne, Ind. | 22.80 | 1000 |
| WRNY (W2XAL) | New York, N. Y. | 30.91 | 500 |
| WSM (4XD) | Nashville, Tenn. | 31.43 | |
| WTFF | Mt. Vernon, Va. | 56.00 | |

*(Several short waves are used for transatlantic telephony. This is private business, not broadcasting.)*

# Foreign Radio Broadcast Stations

## Including U. S. Possessions

| Call Letters | BROADCAST STA. Location | Wave Length | Power (Watts) |
|---|---|---|---|
| | **ALASKA** | | |
| KFIU | Juneau | 225.4 | 10 |
| KFQD | Anchorage | 344.6 | 100 |
| KGBU | Ketchikan | 399.8 | 500 |
| | **ALGERIA** | | |
| 8DB | Algiers | 310 | 100 |
| | **ARGENTINA** | | |
| LOJ | Buenos Aires | 270 | 1000 |
| LOL | Buenos Aires | 236 | 2000 |
| LON | Buenos Aires | 210 | 5000 |
| LOO | Buenos Aires | 252 | 1000 |
| LOP | La Plata | 425 | 1000 |
| LOQ | Buenos Aires | 261.8 | 3000 |
| LOR | Buenos Aires | 344.8 | 1000 |
| LOS | Buenos Aires | 291.2 | 5000 |
| LOT | Buenos Aires | 400 | 1000 |
| LOU | Mendoza | 280 | 500 |
| LOV | Buenos Aires | 361.5 | 1000 |
| LOW | Buenos Aires | 303 | 1000 |
| LOX | Buenos Aires | 380 | 1000 |
| LOY | Buenos Aires | 315.2 | 1000 |
| LOZ | Buenos Aires | 330 | 1000 |
| B2 | Buenos Aires | 275 | 100 |
| D3 | Buenos Aires | 253.3 | 100 |
| F1 | Sante Fe | 279 | 30 |
| F2 | Rosario | 270 | 100 |
| H5 | Cordoba | 275 | 100 |
| H6 | Cordoba | 250 | 20 |
| M6 | Mendoza | 348 | 10 |
| | **AUSTRALIA** | | |
| 2BE | Sydney | 326 | 20 |
| 2BL | Sydney | 353 | 1000 |
| 2FC | Sydney | 442 | 2000 |
| 2GB | Sydney | 326 | 1500 |
| 2HD | Newcastle | 288 | 20 |
| 2KY | Sydney | 280 | 300 |
| 2ME | Sydney | 28.5 | |
| 2MK | Bathurst | 275 | 250 |
| 2UW | Northbridge | 263 | 100 |
| 2VE | Sydney | 297 | 50 |
| 2WA | Sydney | 462 | 100 |
| 3AR | Melbourne | 484 | 320 |
| 3EO | Mildura | 286 | 20 |
| 3LO | Melbourne | 371 | 1000 |
| 3UZ | Melbourne | 319 | 20 |
| 3WR | Melbourne | 303 | 20 |
| 4GM | Brisbane | 278 | 50 |
| 4GR | Toowomba | 294 | 20 |
| 4MB | Brisbane | 337 | 250 |
| 4QG | Brisbane | 385 | 1000 |
| 4RN | Rockhampton | 323 | 100 |
| 5CL | Adelaide | 392 | 1000 |
| 5DN | Adelaide | 313 | 100 |
| 6AG | Perth | 32.9 | |
| 6WF | Perth | 1250 | 1000 |
| | **AUSTRIA** | | |
| ORV | Vienna | 517.2 | 14000 |
| | Graz | 365.8 | 500 |
| | Innsbruck | 294.1 | 500 |
| | Klagenfurt | 272.7 | 500 |
| | Linz | 254.2 | 500 |
| | Vienna | 577 | |
| | **BELGIUM** | | |
| BAV | Brussels | 508.5 | 1500 |
| | Antwerp | 265.5 | 100 |
| | Brussels | 230 | |
| | Ghent | 275 | |
| | Liege | 205 | 100 |
| | Liege | 294.1 | 100 |
| | **BOLIVIA** | | |
| | La Paz | 175 | 50 |
| | La Paz | 300 | 50 |
| | **BRAZIL** | | |
| RSR | Porto Alegre | 381 | 80 |
| SKV | Bahai | 600 | 50 |
| SQAA | Rio de Janeiro | 400 | 2000 |
| SQAB | Rio de Janeiro | 310 | 500 |
| SQAD | Bahia | 445 | 50 |
| SQAF | Curytiba | 240 | 8 |
| SQAG | Sao Paulo | 350 | 1000 |
| SQAI | Santos | 280 | 10 |
| SQAJ | Rio de Janeiro | 260 | 500 |
| SQAK | Ribeirao Preto | 350 | |
| SQAY | Juiz de Fora | 380 | 200 |
| SQBO | Sao Paulo | 225.4 | 1000 |
| SQBE | Bahia | 24 | |
| | Para | 34 | |
| | Pernambuco | 310 | |
| | Sorocaba | 425 | |

| Call Letters | BROADCAST STA. Location | Wave Length | Power (Watts) |
|---|---|---|---|
| | **CANARY ISLANDS** | | |
| EAR5 | Las Palmas | 250 | 200 |
| | **CEYLON** | | |
| | Colombo | 800 | 1500 |
| | **CHILE** | | |
| CMAC | Santiago | 360 | 1000 |
| CMAD | Santiago | 320 | 1000 |
| CMAE | Santiago | 280 | 100 |
| CMAI | Concepcion | 345 | 1500 |
| CMAK | Temuco | 245 | 100 |
| CMAO | Antofagasta | | |
| CMAT | Tacna | 550 | 200 |
| | Asuncion | 12 | |
| | Valparaiso | 400 | 50 |
| | **CHINA** | | |
| CEC | Tientsin | 280 | 50 |
| COHB | Harbin | 445 | |
| COMK | Mukden | 425 | 2000 |
| COTN | Tientsin | 480 | 500 |
| GOW | Victorio | 300 | 1500 |
| KRC | Shanghai | 342 | 250 |
| RSC | Shanghai | 342 | 250 |
| VPS3 | Victoria | 800 | |
| XOL | Tientsin | 480 | 500 |
| | Shanghai | 342 | 250 |
| | **CHOSEN** | | |
| JODK | Seoul | 357 | 1000 |
| | **CUBA** | | |
| CMC | Havana | 347 | 500 |
| PWIH | Havana | 376 | 500 |
| IAZ | Guanajay | 275 | 30 |
| 2AB | Havana | 250 | 10 |
| 2AZ | Havana | 334 | 30 |
| 2BB | Havana | 250 | 15 |
| 2CP | Havana | 280 | 10 |
| 2FG | Hershey | 226 | 20 |
| 2HP | Havana | 205 | 200 |
| 2JF | Mariano | 252 | 15 |
| 2JP | Havana | 245.5 | 15 |
| 2JL | Mariano | 294 | 7½ |
| 2LC | Havana | 303 | 30 |
| 2MA | Mariano | 277 | 50 |
| 2MG | Havana | 284 | 20 |
| 2OH | Havana | 300 | 15 |
| 2OK | Havana | 350 | 100 |
| 2OL | Havana | 257 | 100 |
| 2RK | Havana | 326 | 50 |
| 2SE | Havana | 211 | 10 |
| 2SW | Mariano | 274 | 7½ |
| 2TW | Havana | 270 | 30 |
| 2UF | Havana | 228 | 100 |
| 2WX | Havana | 261 | 150 |
| 2XA | Havana | 230 | 200 |
| 2XX | Havana | 275 | 10 |
| 5DW | Matanzas | 270 | |
| 5EV | Colon | 360 | 100 |
| 6BY | Cienfuegos | 260 | 200 |
| 6EV | Caibarien | 250 | 50 |
| 6HS | Sagua la Grande | 200 | 10 |
| 6JQ | Cienfuegos | 275 | 10 |
| 6KC | Cienfuegos | 240 | |
| 6KP | Sancti Spiritus | 280 | 20 |
| 6KW | Tuinieu | 368 | 100 |
| 6LO | Caibarien | 325 | 250 |
| 6MN | Santa Clara | 210 | 20 |
| 6XJ | Tuinieu | 278 | |
| 6YR | Camajuani | 200 | 20 |
| 7AZ | Camaguey | 225 | 10 |
| 7BY | Ciego de Avila | 235 | 20 |
| 7EV | Camaguey | 190 | |
| 7FU | Ciego de Avila | 200 | 15 |
| 7GT | Camaguey Armanda Vaquer | 195 | 5 |
| 7HS | Ciego de Avila | 192 | 15 |
| 7IR | Ciego de Avila | 193 | |
| 7LO | Camaguey | 230 | 20 |
| 7NM | Nuevitos | 264 | 20 |
| 7SR | Elia | 350 | 300 |
| 8BY | Santiago | 150 | 30 |
| 8HS | Santiago | 200 | 30 |
| 8IR | Santiago | 190 | 20 |
| 8KP | Caney | 180 | 100 |
| 8KW | Santiago | 250 | 15 |
| 8LC | Caney | 300 | 100 |
| | **CZECHOSLOVAKIA** | | |
| OKB | Brunn | 441.2 | 2400 |
| OKK | Kosice | 263 | 2000 |
| OKP | Prague | 384.9 | 5000 |
| OKR | Bratislava | 300 | 500 |
| | Kosice | 1870 | |
| | **DENMARK** | | |
| | Copenhagen | 339.8 | 1000 |
| | Kalundborg | 1535 | 7500 |
| | Ryvang | 1150 | 1000 |
| | Soro | 1153.8 | 1500 |
| | **DUTCH EAST INDIES** | | |
| ANE | Bandoeng | 310 | 6 |
| ANH | Malabor | | |
| JFC | Batavia | 220.7 | 40 |
| | Surabaya | 140 | 500 |
| | Surabaya | 175 | |
| | **EGYPT** | | |
| SRE | Cairo | 225 | |
| | **ESTHONIA** | | |
| | Tallinn | 408 | 700 |
| | Tallinn | 1200 | 100 |
| | **FINLAND** | | |
| 3NB | Tammerfors (Tampere) | 400 | 250 |
| | Bjorneborg | 254.2 | 100 |
| | Helsingfors | 500 | 1000 |
| | Helsingfors | 240 | 2000 |
| | Jacobstad (Pietersarrki) | 275 | 200 |
| | Jyvaskyla | 297 | 200 |
| | Lahtis | 1525 | 40,000 |
| | Lahtis | 318 | 180 |
| | Mikeli | 566 | 250 |
| | Uleaborg | 250 | 250 |
| | Viborg | 240 | 750 |
| | **FRANCE** | | |
| 2BD | Agen | 297 | 500 |
| 5NG | Paris | 340.9 | 500 |
| 8AJ | Paris | 1780 | 100 |
| 8GF | Strasbourg | 222.2 | 250 |
| F8GC | Paris | 350 | 500 |
| CFR | Paris | 1750 | 3000 |
| FL | Paris | 458 | 1000 |
| FPTT | Paris | 238 | 200 |
| MRD | Toulouse | 260 | 1000 |
| YN | Lyon | 480 | 1000 |
| YR | Lyon | 290 | 5000 |
| | Agen | 30.75 | |
| | Beziers | 180 | 500 |
| | Biarritz | 198 | 250 |
| | Bordeaux | 419 | 1500 |
| | Fecamp | 200 | |
| | Grenoble | 416 | 150 |
| | Juan-les-Pins | 246 | 500 |
| | Lille | 246 | 500 |
| | Limoges | 285 | 500 |
| | Marseilles | 300 | 1000 |
| | Mont-de-Marsan | 390 | 300 |
| | Montpelier | 238 | 200 |
| | Nancy | 15.5 | |
| | Nice | 246 | |
| | Nimes | 249 | |
| | Paris | 308 | 250 |
| | Paris | 350 | |
| | Paris | 37 | |
| | Rennes | 294 | 1500 |
| | Toulouse | 389.6 | 2000 |
| | **GERMANY** | | |
| AB | Berlin | 566 | 2000 |
| AFT | Berlin | 1648 | 8000 |
| BMN | Bremen | 387.1 | 1500 |
| HA | Hamburg | 391.6 | 4000 |
| KAV | Norddeich | 1829 | |
| LA | Langenberg | 462.2 | 25000 |
| LP | Frankfort-on-the-Main | 421.3 | 4000 |
| MR | Leipzig | 361.9 | 4000 |
| MS | Muenster | 265.5 | 1500 |
| OKP | Stuttgart | 374.1 | 4000 |
| SMXQ | Cologne | 263.2 | 4000 |
| | Aix-la-Chapelle | 455.9 | 750 |
| | Augsburg | 566 | 700 |
| | Berlin | 438.9 | 800 |
| | Berlin | 475.4 | 4000 |
| | Berlin | 2525 | 5000 |
| | Breslau | 321.2 | 5000 |
| | Danzig | 272.7 | |
| | Dortmund | 283 | 750 |
| | Dresden | 387.1 | 700 |
| | Elberfeld | 468.8 | 750 |
| | Flensburg | 219 | |
| | Freiburg im Breisgau | 577 | 750 |
| | Gleiwitz | 326.4 | 750 |
| | Hanover | 566 | 750 |
| | Kaiserlautern | 204.1 | 4000 |
| | Kassel | 250 | 750 |
| | Kiel | 250 | 750 |
| | Koenigsberg | 280.4 | 4000 |
| | Munich | 536.7 | 4000 |
| | Nuremberg | 240 | 4000 |
| | Schoerbeek | 230 | |
| | Stettin | 236.2 | 500 |

THIS listing of foreign broadcast stations of the world, up to the present listing, is correct, although undoubtedly some changes will be made after going to press. In many cases, reliable information about programs, wave length and power of the stations cannot be obtained even from the stations themselves.

| | | | |
|---|---|---|---|
| | **HAITI** | | |
| HHK | Port-au-Prince | 361.2 | 1000 |
| | **HAWAII** | | |
| KGU | Honolulu | 270.1 | 600 |
| KGHB | Honolulu | 227.1 | 250 |
| | **HUNGARY** | | |
| MT1 | Budapest | 555.6 | 2000 |
| MT2 | Budapest | 1050 | 400 |
| MT3 | Budapest | | 12000 |
| | **ICELAND** | | |
| G2SH | Akureyri | 192 | |
| | Reykjavik | 333.3 | 500 |
| | **INDIA** | | |
| 2AX | Bombay | 320 | 50 |
| 2FV | Bombay | 387 | 100 |
| 2GR | Madras | 400 | 200 |
| 2HZ | Rangoon | 350 | 40 |
| 7BY | Bombay | 357.1 | 3000 |
| 7CA | Calcutta | 370.4 | 4000 |
| VUB | Bombay | 357.1 | |
| VUC | Calcutta | 370.4 | |
| VPB | Colombo | 800 | |
| | **IRISH FREE STATE** | | |
| 2RN | Dublin | 319.1 | 1500 |
| 6CK | Cork | 400 | 1000 |
| | **ITALY** | | |
| I1AX | Rome | 45 | |
| 1MI | Milan | 315.8 | 7000 |
| 1NA | Naples | 333.3 | 1500 |
| 1RO | Rome | 449 | 3000 |
| | Genoa | | 6000 |
| | **JAPAN** | | |
| JOAK | Tokyo | 375 | 1000 |
| JOBK | Osaka | 385 | 1000 |
| JOCK | Nagoya | 360 | 1000 |
| JODK | Keijo | 357 | 1000 |
| JOFK | Hiroshima | 353 | 10000 |
| JOGK | Kumamoto | 380 | 2000 |
| JOHK | Sandai | 390 | 1000 |
| JOIK | Sapporo | 361 | 1000 |
| | **KENYA** | | |
| 7LO | Nairobi | 35 | |
| | | 400 | |
| | **KWANTUNG** | | |
| JQAK | Dairen | 395 | 5000 |
| | **LATVIA** | | |
| KCX | Riga | 526.3 | 2000 |
| | **LITHUANIA** | | |
| | Kuanas | 2000 | |
| | Kovno | 2000 | |
| | **LUXEMBURG** | | |
| LOAA | Luxemburg | 217.4 | 250 |
| | **MEXICO** | | |
| CYA | Mexico City | 300 | 500 |
| CYB | Mexico City | 275 | 500 |
| CYC | Vera Cruz | 337 | 50 |
| CYD | Vera Cruz | 250 | 500 |
| CYF | Oaxaca | 265 | 100 |
| CYH | Mexico City | 375 | 100 |
| CYH | Monterey | | |
| CYJ | Mexico City | 400 | 2000 |
| CYL | Mexico City | 400 | 500 |
| CYM | Torreon | 225 | 1500 |
| CYO | Mexico City | 425 | 100 |
| CYQ | Tampico | 322 | 100 |
| CYR | Mazatlan | 475 | 250 |
| CYS | Monterey | 311 | 250 |
| CYU | Pueblo | 312 | 100 |
| CYX | Mexico City | 325 | 500 |
| CYY | Merida | 549 | 100 |
| CYZ | Tampico | 20 | |
| CXE | Mexico City | 350 | 500 |
| CZF | Chihuahua | 310 | 250 |
| XEA | Guadalajara | 250 | 10 |
| XES | Cindad Lerdo | 250 | |
| XFC | Jalapa | 475 | |
| XFF | Chihuahua | 325 | |
| | **MOROCCO** | | |
| CNO | Casablanca | 305 | 25 |
| | Rabat | 414 | |
| | **NETHERLANDS** | | |
| PCFF | De Bilt | 1470 | 1250 |
| PCLL | Kootwijk | 184 | 25,000 |
| HDO | Hilversum | 1060 | 1000 |
| | Scheveningen | 1875 | 2500 |
| | Huizen | 340.9 | |
| | | 1840 | |
| | **NETHERLANDS EAST INDIES** | | |
| | Soerabaya | 90 | |
| | **NEW ZEALAND** | | |
| 1YA | Auckland | 420 | 500 |
| 1YC | Whangerei | 250 | 15 |
| 1ZB | Auckland | 275 | |
| 1ZQ | Auckland | 253 | 50 |
| 2YA | Wellington | 420 | 5000 |
| 2YK | Wellington | 295 | 60 |
| 2ZA | Wanganui | 500 | |
| 2ZM | Gisborne | 260 | 500 |
| 3AC | Christchurch | 400 | 500 |
| 3YA | Christchurch | 306 | 500 |
| 4YA | Dunedin | 380 | 110 |
| 4ZB | Otago | 300 | |
| 4ZL | Dunedin | 252 | |
| 4ZM | Dunedin | 277.8 | |
| 22F | Palmerston | 280 | |
| | **NORWAY** | | |
| OSLO | Oslo | 270.4 | 1500 |
| | Aalesund | 511 | |
| | Bergen | 370.4 | |
| | Bergen | 370.4 | 1500 |
| | Fredrikstad | 434.8 | 750 |
| | Natodden | 411 | 700 |
| | Porsgrund | 405 | 1000 |
| | Rjuken | 447.8 | 250 |
| | Stavanger | 277.6 | 1500 |
| | Tromso | 500 | |
| | Trondhjem | 243.9 | 1000 |
| | **PERU** | | |
| OAX | Lima | 360 | 1500 |
| | **PHILIPPINE ISLANDS** | | |
| KPM | Iliolo | 400 | 500 |
| KZIB | Manila | 260 | 500 |
| KZKZ | Manila | 270 | 500 |
| KZRQ | Manila | 385 | 1000 |
| | **POLAND** | | |
| AXO | Warsaw | 1111.1 | 8000 |
| | Katowice | 422 | 2000 |
| | Krakow | 422 | 1300 |
| | Poznan | 270.3 | 1500 |
| | Wilna | 435 | |
| | **PORTO RICO** | | |
| WKAQ | San Juan | 322.4 | 500 |
| | **PORTUGAL** | | |
| PIAA | Lisbon | 305 | 500 |
| | **ROUMANIA** | | |
| | Bucharest | 401.6 | |
| | **SAN SALVADOR** | | |
| AQM | San Salvador | 482 | 500 |
| | **SENEGAL** | | |
| | St. Louis | 300 | 100 |
| | **SPAIN** | | |
| EAJI | Barcelona | 344.8 | 1000 |
| EAJ2 | Madrid | 420 | 600 |
| EAJ3 | Cadiz | 400 | 1000 |
| EAJ7 | Madrid | 375 | 1200 |
| EAJ8 | San Sebastian | 297 | 3000 |
| EAJ9 | Bilbao | 434.8 | 1000 |
| EAJ13 | Barcelona | 462 | 1000 |
| EAJ16 | Cartagena | 330 | 1000 |
| EAJ17 | Seville | 434.8 | 600 |
| EAJ18 | Almeria | 320 | 1000 |
| EAJ19 | Oviedo (Cima) | 280.4 | 200 |
| EAJ22 | Salamanca | 500 | 500 |
| EAJ25 | Malaga | 100 | 100 |
| | **STRAITS SETTLEMENTS** | | |
| 1SE | Singapore | 330 | 100 |
| | **SWEDEN** | | |
| SASA | Stockholm | 454.5 | 1000 |
| SASB | Goteborg | 416.1 | 600 |
| SASC | Malmo | 260.9 | 600 |
| SASD | Sundsvall | 545.6 | 600 |
| SASE | Boden | 1190 | 600 |
| SASF | Ostersund | 720 | 600 |
| SASG | Motala | 1380 | 30000 |
| SMRM | Uppsala | 500 | 150 |
| SMSB | Halmstad | 215.8 | 200 |
| SMSL | Hudiksvall | 272.7 | 160 |
| SMSM | Karlskrona | 196 | 200 |
| SMSN | Umea | 229 | 200 |
| SMSO | Varberg | 297 | 300 |
| SMTG | Kiruna | 238.1 | 400 |
| SMTI | Orebro | 236.2 | 200 |
| SMTJ | Kristinehamn | 202.7 | 250 |
| SMTS | Saffle | 252.1 | 400 |
| SMUC | Eskilstuna | 250 | 200 |
| SMUW | Linkoping | 500 | 200 |
| SMVV | Norkoping | 275.2 | 250 |
| SMXF | Gavle | 204.1 | 200 |

| Call Letters | BROADCAST STA. Location | Wave Length | Power (Watts) |
|---|---|---|---|
| SMXG | Karlstad | 220.6 | 250 |
| SMXO | Molmbergt | 400 | 250 |
| SMXQ | Trolhattan | 278.8 | 400 |
| SMYB | Boras | 230.8 | 150 |
| SMYE | Helsingborg | 229 | 200 |
| SMZA | Ormskoeldsvik | 222.2 | 200 |
| SMZD | Jonkopings | 201.3 | 250 |
| SMZK | Falun | 335.3 | 500 |
| SMZP | Uddevalla | 294.1 | 500 |
| | Hamar | 555.8 | — |
| | **SWITZERLAND** | | |
| HBA | Berne | 407 | 1500 |
| HBI | Geneva | 760 | 500 |
| HBZ | Zurich | 500 | 1500 |
| HB2 | Lausanne | 850 | 600 |
| HB3 | Basel | 1000 | 300 |
| | **TUNISIA** | | |
| TNU | Carthage | 1850 | 5000 |
| TUA | Tunis | 1450–45 | 100 |
| 8KR | Constantine | 42.8 | |
| | **TURKEY** | | |
| | Angora | 1806 | 6000 |
| | Osmanieh | 1200 | 6000 |
| | Stamboul | 1200 | 15000 |
| | **UNION OF SOUTH AFRICA** | | |
| JB | Johannesburg | 32 | |
| | | 443.5 | 900 |
| WAMG | Capetown | 372 | 1200 |
| | Durban | 398 | 1200 |
| | Pretoria | 323 | |
| | **UNION OF SOVIET SOCIALIST REPUBLICS (Formerly Russia)** | | |
| RA1 | Moscow | 1450 | 40000 |
| RA2 | Moscow | 450 | 500 |
| RA4 | Moscow | 450 | 300 |
| RA7 | Ivanova-Vosnensensk | 800 | 180 |
| RA8 | Bogorodsk | 750 | 700 |
| RA9 | Sevastopol | 900 | 250 |
| RA11 | Tiflis | 870 | 4000 |
| RA12 | Voronezh | 950 | 240 |
| RA13 | Nizhni-Novgorod | 840 | 1800 |
| RA14 | Rostov-on-Don | 820 | 4000 |
| RA15 | Sverdlovks | 1050 | 500 |
| RA16 | Vel Ustjuk | 620 | 1200 |
| RA17 | Vladivostok | 480 | 1500 |
| RA18 | Minsk | 860 | 1200 |
| RA20 | Stavropol | 550 | 1200 |
| RA21 | Tomsk | 300 | 150 |
| RA22 | Samara | 900 | 1200 |
| RA25 | Orenburg | 640 | 1000 |
| RA26 | Astrakham | 700 | 1000 |
| RA27 | Tashkent | 751 | 2000 |
| RA30 | Dneipropetrovsk | 525 | 1000 |
| RA32 | Novorossisk | 1117 | 4000 |
| RA32 | Saratov | 420 | 200 |
| RA34 | Koursk | 575 | 1000 |
| RA38 | Krasnodar | 513 | 1000 |
| RA39 | Gomel | 925 | 1200 |
| RA40 | Odessa | 975 | 1200 |
| RA41 | Vologda | 875 | 1200 |
| RA42 | Leningrad | 1000 | 10000 |
| RA43 | Kharkov | 475 | |
| | | 1700 | 4000 |
| RA44 | Tver | 690 | 1200 |
| RA45 | Kiev | 775 | 1200 |
| RA45 | Baku | 750 | 4000 |
| RA46 | Petrozavodsk | 765 | 2000 |
| RA47 | Armavir | 720 | 200 |
| RA49 | Erivan | 1050 | 1200 |
| RA51 | Ulyanovsk | 500 | 20 |
| RA56 | Artemovsk | 790 | 1200 |
| RA57 | Irkutsk | 1100 | 500 |
| RA59 | Leningrad | 150 | 350 |
| RA64 | Petropavlovsk | 350 | 45 |
| RA67 | Nalchik | 1070 | 240 |
| RA68 | Smolensk | 330 | 20 |
| RA72 | Smolensk | 150 | 800 |
| RA77 | Stalino | 730 | 1200 |
| RDW | Moscow | 1450 | 12000 |
| | **UNITED KINGDOM** | | |
| 2BD | Aberdeen | 500 | 1500 |
| 2BE | Belfast | 306.1 | 1500 |
| 2DE | Dundee | 294 | 200 |
| 2EH | Edinburgh | 288.5 | 500 |
| 2LO | London | 297 | 200 |
| 2LS | Leeds | 277.8 | 500 |
| 2LS | Bradford | 252.1 | 200 |
| 2NM | Caterham | 32.5 | |
| 2ZY | Manchester | 384.6 | 1500 |
| 5GB | Daventry | 323.2 | 25000 |
| 5IT | Birmingham | 326.1 | 1500 |
| 5NG | Nottingham | 275.2 | 200 |
| 5NO | Newcastle | 312.5 | 1500 |
| 5PY | Plymouth | 400 | 200 |
| 5SC | Glasgow | 405.4 | 1500 |
| 5SW | Daventry | 24 | |
| 5SX | Swansea | 294 | 200 |
| 5WA | Cardiff | 353 | 1500 |
| 5XX | Daventry | 1600 | 16000 |
| 6BM | Bournemouth | 491.8 | 1500 |
| 6FL | Sheffield | 272.7 | 200 |
| 6KH | Hull | 294 | 200 |
| 6LV | Liverpool | 297 | 200 |
| 6ST | Stoke-on-Trent | 294 | 200 |
| 6SW | Chelmsford | 24 | |
| | **URUGUAY** | | |
| CWOA | Montevideo | 428.4 | 1000 |
| CWOF | Montevideo | 300 | 100 |
| CWOG | Montevideo | 280 | 10 |
| CWOH | Montevideo | 300 | 50 |
| CWOI | Salta | 272 | 50 |
| CWOJ | Salta | 250 | 10 |
| CWOK | Montevideo | 260 | 50 |
| CWOL | Montevideo | 272 | 100 |
| CWOM | Montevideo | 265.5 | 20 |
| CWON | Montevideo | 256.5 | 200 |
| CWOO | Montevideo | 294 | 50 |
| CWOR | Montevideo | 350 | 500 |
| CWOS | Montevideo | 380 | 500 |
| CWOW | Montevideo | 500 | |
| | **VENEZUELA** | | |
| AYRE | Caracas | 375 | 1000 |
| | **YUGOSLAVIA** | | |
| | Zagreb | 309.2 | 100 |

# Foreign Radio Broadcast Stations, Including U. S. Possessions

## By Wave-Lengths

| Wave Length (Meters) | Call Letters | COUNTRIES AND CITIES | Power (Watts) |
|---|---|---|---|
| | | **ALASKA** | |
| 399.8 | KGBU | Ketchikan | 500 |
| 344.8 | KFQD | Anchorage | 100 |
| 225.4 | KFIU | Juneau | 10 |
| | | **ALGERIA** | |
| 310 | 8DB | Algiers | 100 |
| | | **ARGENTINA** | |
| 425 | LOP | La Plata | 1000 |
| 400 | LOT | Buenos Aires | 1000 |
| 380 | LOX | Buenos Aires | 1000 |
| 361.5 | LOV | Buenos Aires | 1000 |
| 348 | M6 | Mendoza | 10 |
| 344.8 | LOR | Buenos Aires | 1000 |
| 330 | LOZ | Buenos Aires | 1000 |
| 315.2 | LOV | Buenos Aires | 1000 |
| 303 | LOW | Buenos Aires | 1000 |
| 291.2 | LOS | Buenos Aires | 5000 |
| 280 | LOU | Mendoza | 500 |
| 279 | F1 | Sante Fe | 30 |
| 275 | H5 | Cordoba | 100 |
| | B2 | Buenos Aires | 100 |
| 270 | F2 | Rosario | 100 |
| | LOJ | Buenos Aires | 1000 |
| 261.8 | LOQ | Buenos Aires | 3000 |
| 253.3 | D3 | Buenos Aires | 100 |
| 252 | LOO | Buenos Aires | 1000 |
| 236 | LOL | Buenos Aires | 2000 |
| 210 | LON | Buenos Aires | 5000 |
| | | **AUSTRALIA** | |
| 1250 | 6WF | Perth | 1000 |
| 484 | 3AR | Melbourne | 320 |
| 464 | 2WA | Sydney | 100 |
| 442 | 2FC | Sydney | 2000 |
| 392 | 5CL | Adelaide | 1000 |
| 385 | 4QG | Brisbane | 1000 |
| 371 | 3LO | Melbourne | 1000 |
| 353 | 2BL | Sydney | 1000 |
| 337 | 4MB | Brisbane | 250 |
| 326 | 2BE | Sydney | 20 |
| | 2GB | Sydney | 1500 |
| 323 | 4RN | Rockhampton | 100 |
| 319 | 3UZ | Melbourne | 20 |
| 313 | 4DN | Adelaide | 100 |
| 303 | 3WR | Melbourne | 20 |
| 297 | 2VE | Sydney | 50 |
| 294 | 4GR | Toowomba | 20 |
| 288 | 2HD | Newcastle | 20 |
| 286 | 3EO | Mildura | 20 |
| 280 | 2KY | Sydney | 300 |
| 278 | 4GM | Brisbane | 50 |
| 275 | 2MK | Bathurst | 250 |
| 263 | 2UW | Northbridge | 100 |
| | | **AUSTRIA** | |
| 577 | | Vienna | |
| 517.2 | ORV | Vienna | 14000 |
| 365.8 | | Graz | 500 |
| 294.1 | | Innsbruck | 500 |
| 272.7 | | Klagenfurt | 500 |
| 254.2 | | Linz | 500 |
| | | **BELGIUM** | |
| 508.5 | BAV | Brussels | 1500 |
| 294.1 | | Liege | 100 |
| 275 | | Ghent | |
| 265.5 | | Antwerp | 100 |
| 230 | | Brussels | |
| 205 | | Liege | |
| | | **BOLIVIA** | |
| 300 | | La Paz | 50 |
| 175 | | La Paz | 50 |
| | | **BRAZIL** | |
| 600 | SKV | Bahia | 50 |
| 445 | SQAD | Bahia | 50 |
| 425 | | Sorocaba | |
| 400 | SQAA | Rio de Janeiro | 2000 |
| 381 | RSR | Porto Alegre | 80 |
| 380 | SQAY | Juiz de Fora | 200 |
| 350 | SQAG | Sao Paulo | 1000 |
| | SQAK | Ribeirao Preto | |
| 310 | SQAB | Rio de Janeiro | 500 |
| | | Pernambuco | |
| 280 | SQAI | Santos | 10 |
| 260 | SQAJ | Rio de Janeiro | 500 |
| 240 | SQAF | Curytiba | 8 |
| 225.4 | SQBO | Sao Paulo | 1000 |
| 34 | | Para | |
| 24 | | Bahia | |
| | | **CANARY ISLANDS** | |
| 350 | EARS | Las Palmas | 200 |
| 250 | | | |
| | | **CHILE** | |
| 550 | CMAT | Tacna | 200 |
| 400 | | Valparaiso | 50 |
| 360 | CMAC | Santiago | 1000 |
| 345 | CMAI | Concepcion | 1500 |
| 320 | CMAD | Santiago | 1000 |
| 280 | CMAE | Santiago | 100 |
| 245 | CMAK | Temuco | 100 |
| 12 | | Asuncion | |
| | CMAO | Antofagasta | |
| | | **CHINA** | |
| 800 | VPS3 | Victoria | |
| 480 | COTN | Tientsin | 500 |
| | XOL | Tientsin | 500 |
| 445 | COHB | Harbin | |
| 425 | COMK | Mukden | 2000 |
| 342 | KRC | Shanghai | 250 |
| | RSC | Shanghai | 250 |
| | | Shanghai | 250 |
| 300 | GOW | Victoria | 1500 |
| 280 | CEC | Tientsin | 50 |
| | | **CHOSEN** | |
| 357 | JODK | Seoul | 1000 |
| | | **CUBA** | |
| 376 | PWIH | Havana | 500 |
| 368 | 6KW | Tuinieu | 100 |
| 360 | 5EV | Colon | 100 |
| 350 | 2OK | Havana | 100 |
| | 7SR | Elia | 300 |
| 347 | CMC | Havana | 500 |
| 334 | 2AZ | Guanajay | 30 |
| 326 | 2RK | Havana | 50 |
| 325 | 6LO | Caibarien | 250 |
| 303 | 2LC | Havana | 30 |
| 300 | 2OH | Havana | 15 |
| | 8LC | Caney | 100 |
| 294 | 2JL | Mariano | 7½ |
| 284 | 2MG | Havana | 20 |
| 280 | 2CP | Havana | 10 |
| | 6KP | Sancti Spiritus | 20 |
| 278 | 6XJ | Tuinieu | |
| 277 | 2MA | Mariano | 50 |
| 275 | 1AZ | Guanajay | 30 |
| | 2XX | Havana | 10 |
| | 6JQ | Cienfuegos | 10 |
| 274 | 2SW | Mariano | 7½ |
| 270 | 2TW | Havana | 30 |
| | 5DW | Matanzas | |
| 264 | 7NM | Nuevitos | 20 |
| 261 | 2WX | Havana | 150 |
| 260 | 6BY | Cienfuegos | 200 |
| 257 | 2OL | Havana | 100 |
| 252 | 2JF | Mariano | 15 |
| 250 | 2AB | Havana | 10 |
| | 2BB | Havana | 15 |
| | 6EV | Caibarien | 50 |
| | 8KW | Santiago | 15 |
| 245.5 | 2JP | Havana | 15 |
| 240 | 6KC | Cienfuegos | |
| 235 | 7BY | Ciego de Avila | 20 |
| 230 | 2XA | Havana | 200 |
| | 7LO | Camaguey | 20 |
| 228 | 2UF | Havana | 100 |
| 226 | 2FG | Hershey | 20 |
| 225 | 7AZ | Camaguey | 10 |
| 211 | 2SE | Havana | 10 |
| 210 | 6MN | Santa Clara | 20 |
| 205 | 2HP | Havana | 200 |
| 200 | 6HS | Sagua la Grande | 10 |
| | 6YR | Camajuani | 20 |
| | 7FU | Ciego de Avila | 15 |
| | 8HS | Santiago | 30 |
| 195 | 7GT | Camaguey Armanda Vaquer | 5 |
| 193 | 7IR | Ciego de Avila | 15 |
| 192 | 7HS | Ciego de Avila | 15 |
| 190 | 7EV | Camaguey | |
| | 8IR | Santiago | 20 |
| 180 | 8KP | Caney | 100 |
| 150 | 8BY | Santiago | 30 |
| | | **CZECHOSLOVAKIA** | |
| 1870 | | Kosice | |
| 441.2 | OKB | Brunn | 2400 |
| 384.9 | OKP | Prague | 5000 |
| 300 | OKR | Bratislava | 500 |
| 263 | OKK | Kosice | 2000 |
| | | **DENMARK** | |
| 1535 | | Kalundborg | 7500 |
| 1153.8 | | Soro | 1500 |
| 1150 | | Ryvang | 1000 |
| 339.8 | | Copenhagen | 1000 |
| | | **DUTCH EAST INDIES** | |
| 310 | ANE | Bandoeng | 6 |
| 220 | JFC | Batavia | 40 |
| 175 | | Surabaya | |
| 140 | | Surabaya | 500 |
| | ANH | Malabor | |
| | | **EGYPT** | |
| 225 | SRE | Cairo | |
| | | **ESTONIA** | |
| 1200 | | Tallinn | 100 |
| 408 | | Tallinn | 700 |
| | | **FINLAND** | |
| 1525 | | Lahtis | 40000 |
| 566 | | Mikeli | 250 |
| 500 | | Helsingfors | 1000 |

| Wave Length (Meters) | Call Letters | COUNTRIES AND CITIES | Power (Watts) |
|---|---|---|---|
| 400 | 3NB | Tammerfors (Tampere) | 250 |
| 318 | | Lahtis | 180 |
| 297 | | Jyvaskyla | 200 |
| 275 | | Jacobstad (Pietersarrki) | 200 |
| 254.2 | | Jborneborg | 100 |
| 250 | | Uleaborg | 250 |
| 240 | | Helsingfors | 2000 |
| | | Viborg | 750 |
| | | **FRANCE** | |
| 1780 | 8AJ | Paris | 100 |
| 1750 | CRF | Paris | 3000 |
| 480 | YN | Lyon | 1000 |
| 458 | FL | Paris | 1000 |
| 419 | | Bordeaux | 1500 |
| 416 | | Grenoble | 150 |
| 390 | | Mont-de-Marsan | 300 |
| 389.6 | | Toulouse | 2000 |
| 350 | | Paris | 500 |
| 340.9 | 5NG | Paris | 500 |
| 308 | | Paris | 250 |
| 300 | | Marseilles | 1000 |
| 297 | 2BD | Agen | 500 |
| 294 | | Rennes | 1500 |
| 290 | YR | Lyon | 5000 |
| 285 | | Limoges | 500 |
| 267.3 | | Lille | 500 |
| 260 | MRD | Toulouse | 1000 |
| 249 | | Nimes | |
| 246 | | Juan-les-Pins | 500 |
| 246 | | Nice | |
| 238 | FPTT | Paris | 200 |
| | | Montpelier | 200 |
| 222.2 | 8GF | Strasbourg | 250 |
| 200 | | Fecamp | |
| 198 | | Biarritz | 250 |
| 180 | | Beziers | 500 |
| | | **GERMANY** | |
| 2525 | | Berlin | 5000 |
| 1829 | KAV | Norddeich | |
| 1648 | AFT | Berlin | 8000 |
| 577 | | Breiburg im Breisgau | 750 |
| 566 | AB | Berlin | 2000 |
| | | Augsburg | 700 |
| | | Hanover | 750 |
| 536 | | Munich | 4000 |
| 475.4 | | Berlin | 4000 |
| 468.8 | | Elberfeld | 750 |
| 462.2 | LA | Langenberg | 25000 |
| 455.9 | | Aix-la-Chapelle | 750 |
| 438.9 | | Berlin | 800 |
| 421.3 | LP | Frankfort-on-the-Main | 4000 |
| 391.6 | HA | Hamburg | 4000 |
| 387.1 | | Dresden | 700 |
| | BMN | Bremen | 1500 |
| 374.1 | OKP | Stuttgart | 4000 |
| 361.9 | MR | Leipzg | 4005 |
| 326.4 | | Gleiwitz | 750 |
| 321.2 | | Breslau | 5000 |
| 283 | | Dortmund | 750 |
| 280.4 | | Koenigsberg | 4000 |
| 272.7 | | Danzig | |
| 265.6 | MS | Muenster | 1500 |
| 263.2 | SMXQ | Cologne | 4000 |
| 250 | | Kassel | 750 |
| | | Kiel | 750 |
| 240 | | Nuremberg | 4000 |
| 236.2 | | Stettin | 500 |
| 230 | | Schoerbeek | |
| 219 | | Flensburg | |
| 204.1 | | Kaiserlautern | 4000 |
| | | **HAITI** | |
| 361.2 | HHK | Port-au-Prince | 1000 |
| | | **HAWAII** | |
| 270.1 | KGU | Honolulu | 600 |
| 227.1 | KGHB | Honolulu | 250 |
| | | **HUNGARY** | |
| 1050 | MT2 | Budapest | 400 |
| 555.6 | MT1 | Budapest | 2000 |
| | MT3 | Budapest | 12000 |
| | | **ICELAND** | |
| 333.3 | | Reykjavik | 500 |
| 192 | G2SH | Akureyri | |
| | | **INDIA** | |
| 800 | VPB | Colombo | |
| 400 | 2GR | Madras | 200 |
| 387 | 2FV | Bombay | 100 |
| 370.4 | 7CA | Calcutta | 3000 |
| | VUC | Calcutta | |
| 357.1 | 7BY | Bombay | 3000 |
| | VUB | Bombay | |
| 350 | 2HZ | Rangoon | 40 |
| 320 | 2AX | Bombay | 50 |
| | | **IRISH FREE STATE** | |
| 400 | 6CK | Cork | 1000 |
| 319.1 | 2RN | Dublin | 1500 |
| | | **ITALY** | |
| 449 | 1RO | Rome | 3000 |
| 333.3 | 1NA | Naples | 1500 |
| 315.8 | 1MI | Milan | 7000 |
| 45 | 11AX | Rome | |
| | | Genoa | 6000 |
| | | **JAPAN** | |
| 390 | JOHK | Sandai | 1000 |
| 385 | JOBK | Osaka | 1000 |
| 380 | JOGK | Kumamoto | 2000 |
| 375 | JOAK | Tokyo | 1000 |
| 361 | JOIK | Sapporo | 1000 |
| 360 | JOCK | Nagoya | 1000 |
| 357 | JODK | Keijo | 1000 |
| 353 | JOFK | Hiroshima | 10000 |
| | | **KENYA** | |
| 400 | 7LO | Nairobi | |
| 35 | | | |
| | | **KWANTUNG** | |
| 395 | JQAK | Dairen | 5000 |
| | | **LATVIA** | |
| 526.3 | KCX | Riga | 2000 |
| | | **LITHUANIA** | |
| 2000 | | Kaunas | |
| | | Kovno | |

| Wave Length (Meters) | Call Letters | COUNTRIES AND CITIES | Power (Watts) |
|---|---|---|---|
| | | **LUXEMBURG** | |
| 217.4 | LOAA | Luxemburg | 250 |
| | | **MEXICO** | |
| 549 | CYY | Merida | 100 |
| 475 | CYR | Mazatlan | 250 |
| | XFC | Jalapa | |
| 425 | CYO | Mexico City | 100 |
| 400 | CYJ | Mexico City | 2000 |
| | CYL | Mexico City | 500 |
| 375 | CYH | Mexico City | 100 |
| 350 | CXE | Mexico City | 500 |
| 337 | CYC | Vera Cruz | 50 |
| 325 | CYX | Mexico City | 500 |
| | XFF | Chihuahua | |
| 322 | CYQ | Tampico | 100 |
| 312 | CYU | Pueblo | 100 |
| 311 | CYS | Monterey | 250 |
| 310 | CZF | Chihuahua | 250 |
| 300 | CYA | Mexico City | 500 |
| 275 | CYB | Mexico City | 500 |
| 265 | CYF | Oaxaca | 100 |
| 250 | CYD | Vera Cruz | 500 |
| | XEA | Guadalajara | 10 |
| | XES | Ciudad Lerdo | |
| 225 | CYM | Torreon | 1500 |
| 20 | CYZ | Tampico | 20 |
| | CYH | Monterey | |
| | | **MOROCCO** | |
| 414 | | Rabat | |
| 305 | CNO | Casablanca | 25 |
| | | **NETHERLANDS** | |
| 1875 | | Scheveningen | 2500 |
| 1840 | | Huizen | |
| 1470 | PCFF | DeBilt | 1250 |
| 1060 | HDO | Hilversum | 1000 |
| 340 | | Huizen | |
| 184 | PCLL | Kootwijk | 25000 |
| | | **NETHERLANDS EAST INDIES** | |
| 90 | | Soerabaya | |
| | | **NEW ZEALAND** | |
| 500 | 2ZA | Wanganui | |
| 420 | 1YA | Auckland | 500 |
| | 2YA | Wellington | 5000 |
| 400 | 3AC | Christchurch | 500 |
| 380 | 4YA | Dunedin | 110 |
| 300 | 4ZB | Otago | |
| 295 | 2YK | Wellington | 60 |
| 280 | 22F | Palmerston | |
| 277.8 | 4ZM | Dunedin | |
| 275 | 1ZB | Auckland | |
| 260 | 2ZM | Gisborne | 500 |
| 253 | 1ZQ | Auckland | 50 |
| 252 | 4ZL | Dunedin | |
| 250 | 1YC | Whangerei | 15 |
| | | **NORWAY** | |
| 511 | | Aalesund | |
| 500 | | Tromso | |
| 447.8 | | Rjuken | 250 |
| 434.8 | | Fredrikstad | 750 |
| 411 | | Natodden | 700 |
| 405 | | Porsgrund | 1000 |
| 370.4 | OSLO | Oslo | 1500 |
| | | Bergen | |
| | | Bergen | 1500 |
| 277.6 | | Stavanger | 1500 |
| 243.9 | | Trondhjem | 1000 |
| | | **PERU** | |
| 360 | OAX | Lima | 1500 |
| | | **PHILIPPINE ISLANDS** | |
| 400 | KPM | Iliolo | 500 |
| 385 | KZRQ | Manila | 1000 |
| 270 | KZKZ | Manila | 500 |
| 260 | KZIB | Manila | 500 |
| | | **POLAND** | |
| 1111.1 | AXO | Warsaw | 8000 |
| 435 | | Wilna | |
| 422 | | Katowice | 2000 |
| | | Krakow | 1300 |
| 270.3 | | Poznan | 1500 |
| | | **PORTO RICO** | |
| 322.4 | WKAQ | San Juan | 500 |
| | | **PORTUGAL** | |
| 305 | PIAA | Lisbon | 500 |
| | | **ROUMANIA** | |
| 401.6 | | Bucharest | |
| | | **SAN SALVADOR** | |
| 482 | AQM | San Salvador | 500 |
| | | **SENEGAL** | |
| 300 | | St. Louis | 100 |
| | | **SPAIN** | |
| 500 | EAJ22 | Salamanca | 500 |
| 462 | EAJ13 | Barcelona | 1000 |
| 434.8 | EAJ9 | Bilbao | 1000 |
| | EAJ17 | Seville | 600 |
| 420 | EAJ2 | Madrid | 600 |
| 400 | EAJ3 | Cadiz | 1000 |
| 375 | EAJ7 | Madrid | 1200 |
| 344.8 | EAJ1 | Barcelona | 1000 |
| 330 | EAJ16 | Cartagena | 1000 |
| 320 | EAJ18 | Almeria | 1000 |
| 297 | EAJ8 | San Sebastian | 3000 |
| 280.4 | EAJ19 | Oviedo (Cima) | 200 |
| 100 | EAJ25 | Malaga | 100 |
| | | **STRAITS SETTLEMENTS** | |
| 330 | 1SE | Singapore | 100 |
| | | **SWEDEN** | |
| 1380 | SASG | Motala | 30000 |
| 1190 | SASE | Boden | 600 |
| 720 | SASF | Ostersund | 600 |
| 555.8 | | Hamar | |
| 545.6 | SASD | Sundsvall | 600 |
| 500 | SMRM | Uppsala | 150 |
| | SMUW | Linkoping | 200 |
| 454.5 | SASA | Stockholm | 1000 |
| 416.1 | SASB | Goteborg | 600 |
| 400 | SMXQ | Molmbergt | 250 |
| 335.3 | SMZK | Falun | 500 |
| 297 | SMSO | Varberg | 300 |

| Wave Length (Meters) | Call Letters | COUNTRIES AND CITIES | Power (Watts) |
|---|---|---|---|
| 294.1 | SMZP | Uddevalla | 500 |
| 278.8 | SMZQ | Trolhattan | 400 |
| 275.2 | SMVV | Norkoping | 250 |
| 272.7 | SMSL | Hudiksvall | 160 |
| 260.9 | SASC | Malmo | 600 |
| 252.1 | SMTS | Saffle | 400 |
| 250 | SMUC | Eskilstuna | 200 |
| 238.1 | SMTG | Kiruna | 400 |
| 236.2 | SMTI | Orebro | 200 |
| 230.8 | SMYB | Boras | 150 |
| 229 | SMSN | Umea | 200 |
| | SMYE | Helsingborg | 200 |
| 222.2 | SMZA | Ormskoeldsvik | 200 |
| 220.6 | SMXG | Karlstad | 250 |
| 215.8 | SMSB | Halmstad | 200 |
| 204.1 | SMXF | Gavle | 200 |
| 202.7 | SMTJ | Kristinehamn | 250 |
| 201.3 | SMZD | Jonkopings | 250 |
| 196 | SMSM | Karlskrona | 200 |
| | | **SWITZERLAND** | |
| 1000 | HB3 | Basel | 300 |
| 850 | HB2 | Lausanne | 600 |
| 760 | HBI | Geneva | 500 |
| 500 | HBZ | Zurich | 1500 |
| 407 | HBA | Berne | 1500 |
| | | **TUNISIA** | |
| 1850 | TUN | Carthage | 5000 |
| 1450 | TUA | Tunis | 100 |
| 45 | TUA | Tunis | 100 |
| 42.8 | 8KR | Constantine | |
| | | **TURKEY** | |
| 1806 | | Angoria | 6000 |
| 1200 | | Osmanieh | 6000 |
| | | Stamboul | 15000 |
| | | **UNION OF SO. AFRICA** | |
| 443.5 | JB | Johannesburg | 900 |
| 398 | | Durban | 1200 |
| 372 | WAMG | Capetown | 1200 |
| 323 | | Pretoria | |
| 32 | JB | Johannesburg | 900 |
| | | **UNION OF SOVIET SOCIALIST REPUBLICS (Formerly Russia)** | |
| 1700 | RA43 | Kharkov | 4000 |
| 1450 | RA1 | Moscow | 40000 |
| | RDW | Moscow | 500 |
| 1117 | RA32 | Novorossisk | 4000 |
| 1100 | RA57 | Irkutsk | 500 |
| 1070 | RA67 | Nalchik | 240 |
| 1050 | RA49 | Erivan | 1200 |
| 1000 | RA42 | Leningrad | 10000 |
| 975 | RA40 | Odessa | 1200 |
| 950 | RA12 | Voronezh | 240 |
| 925 | RA39 | Gomel | 1200 |
| 900 | RA9 | Sevastopol | 250 |
| | RA22 | Samara | 1200 |
| 875 | RA41 | Vologda | 1200 |
| 870 | RA11 | Tiflis | 4000 |
| 860 | RA18 | Minsk | 1200 |
| 840 | RA13 | Nizhni-Novgorod | 1800 |
| 820 | RA14 | Rostov-on-Don | 4000 |
| 800 | RA7 | Ivanova-Vosnensensk | 180 |
| 790 | RA56 | Artemovsk | 1200 |
| 775 | RA45 | Kiev | 1200 |
| 765 | RA46 | Petrozavodsk | 2000 |
| 751 | RA27 | Tashkent | 2000 |
| 750 | RA8 | Bogorodsk | 700 |
| | RA45 | Baku | 4000 |
| 730 | RA77 | Stalino | 1200 |
| 720 | RA47 | Armavir | 200 |
| 700 | RA26 | Astrakhan | 1000 |
| 690 | RA44 | Tver | 1200 |
| 640 | RA25 | Orenburg | 1000 |
| 620 | RA16 | Vel Ustjuk | 1200 |
| 575 | RA34 | Koursk | 1000 |
| 550 | RA20 | Stavropol | 1200 |
| 525 | RA30 | Dniepropetrovsk | 1000 |
| 513 | RA38 | Krasnodar | 1000 |
| 500 | RA51 | Ulyanovsk | 20 |
| 480 | RA17 | Vladivostok | 1500 |
| 475 | RA43 | Kharkov | 4000 |
| 450 | RA2 | Moscow | 500 |
| | RA4 | Moscow | 300 |
| 420 | RA32 | Saratov | 200 |
| 350 | RA64 | Petropavlavsk | 45 |
| 330 | RA68 | Smolensk | 20 |
| 300 | RA21 | Tomsk | 150 |
| 150 | RA72 | Smolensk | 800 |
| | RA59 | Leningrad | 350 |
| | | **UNITED KINGDOM** | |
| 1600 | 5XX | Daventry | 16000 |
| 500 | 2BD | Aberdeen | 1500 |
| 491.8 | 6BM | Bournemouth | 1500 |
| 405.4 | 5SC | Glasgow | 1500 |
| 400 | 5PY | Plymouth | 200 |
| 384.6 | 2ZY | Manchester | 1500 |
| 353 | 5WA | Cardiff | 1500 |
| 326.1 | 5IT | Birmingham | 1500 |
| 323.2 | 5GB | Daventry | 25000 |
| 312.5 | 5NO | Newcastle | 1500 |
| 306.1 | 2BE | Belfast | 1500 |
| 297 | 6LV | Liverpool | 200 |
| | 2LO | London | 200 |
| 294 | 2DE | Dundee | 200 |
| | 5SX | Swansea | 200 |
| | 6KH | Hull | 200 |
| | 6ST | Stroke-on-Trent | 200 |
| 288.5 | 2EH | Edinburgh | 500 |
| 277.8 | 2LS | Leeds | 500 |
| 275.2 | 5NG | Nottingham | 200 |
| 272.7 | 6FL | Sheffield | 200 |
| 252.1 | 2LS | Bradford | 200 |
| 32.5 | 2NM | Caterham | |
| 24 | 5SW | Daventry | |
| | 6SW | Chelmsford | |
| | | **URUGUAY** | |
| 500 | CWOW | Montevideo | |
| 428.4 | CWOA | Montevideo | 1000 |
| 380 | CWOS | Montevideo | 500 |
| 350 | CWOR | Montevideo | 500 |
| 300 | CWOF | Montevideo | 100 |
| | CWOH | Montevideo | 50 |
| 294 | CWOO | Montevideo | 50 |
| 280 | CWOG | Montevideo | 10 |
| 272 | CWOI | Salta | 50 |
| | CWOL | Montevideo | 100 |
| 265.5 | CWOM | Montevideo | 20 |
| 260 | CWOK | Montevideo | 50 |
| 256.5 | CWON | Montevideo | 10 |
| 250 | CWOJ | Salta | 200 |
| | | **VENEZUELA** | |
| 375 | AYRE | Caracas | 1000 |
| | | **YUGOSLAVIA** | |
| 309.2 | | Zagreb | 100 |

# *This* Laboratory Instrument *Has Many Uses*

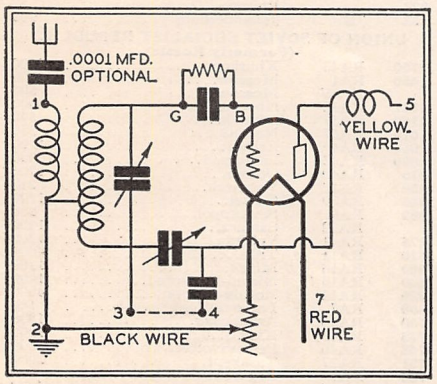
*By* George W. Walker

**MR. WALKER, of Victoreen fame, is the designer of the very versatile unit which is described here. Undoubtedly, to the experienced experimenter many other uses besides the few which are explained here will suggest themselves.**

**The serviceman, the laboratory research worker and the dyed-in-the-wool set builder will find in this veritable Jack of All Trades just the device which will make his work simpler and more accurate.**

BOYS of today may be intrigued by more modern and more expensive playthings; but what father of such youngsters does not recall how he once prized, or longed to possess, that mark of youthful affluence—a "combination" pocket knife?

Memory fails to bring back all of the things that this strange-looking blend of tool box, manicure set, surgical kit, etc., could be made to accomplish. But equal to almost any juvenile task were the large, small and middle-sized blades; the screw driver, chisel and file, *the cork-screw, bottle opener,* nail puller, scratch awl and divers other appliances.




**The circuit diagram of the multi-unit when used as a short-wave adapter, connected by means of the cable-plug to the detector socket of a broadcast receiver**

Mothers of the time when such treasures flourished would attest to their destructive influence upon pockets of pants or overalls. For it was difficult to make one handle contain all of the tools hinged to it; hence, a lot of projecting points and edges.

And now the boat-building, whistle-making, initial-carving boys of yesterday are the radio owners and experimenters of today, with the urge as strong as ever to make or make over things. Chiefly different is the sort of combination instrument they need to make new receiving sets, or to make old ones newer and better.

To be sure, it is slightly larger than pocket size, and its contents are coils, condensers, wires and things, rather than tools. But just as capable of delighting the boy of today and yesterday is the radio device described here, with its almost unlimited number of circuit variations.

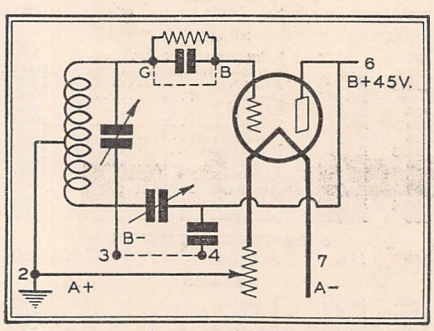
### *A Many-Purpose Radio Device*

To mention only a few, this unit constitutes at will a one-tube set for either broadcast or short waves; a short-wave adapter or converter to operate with a.c. or d.c. receivers; a radio-frequency oscillator, modulated or unmodulated; a pre-amplifier or "booster"; a wave trap, wavemeter, crystal receiver—and all within the compass of 5 x 7 x 3 inches.

Although termed "the unit of a dozen uses at the cost of one," it is difficult to realize how much has been crammed into this small device. Proof is found in accompanying photographs and diagrams, and this description of some applications.

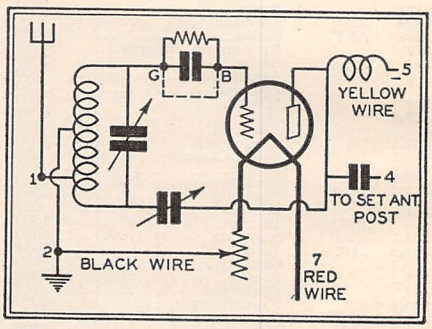
It will be seen that flexibility is achieved by making almost every part of the circuit readily accessible. Condensers, choke, etc., can be included or shorted out, tuning capacity increased, wavelength range altered, regeneration added or eliminated, merely by changing connections at the binding posts, or by shifting coils.

In this era of short-wave transmissions in both voice and code, attention naturally is attracted to such a unit by its ability to tune in stations below the range of broadcast receivers. This it accomplishes either alone or when plugged into the detector socket of a set, to take advantage of the audio amplifier. Such use is illustrated in the diagram Fig. 1. Power for the unit is drawn from the receiver. One of the coils furnished with the unit will cover a band of about 15 to 95 meters. This is the popular short-wave band for broadcast and amateur stations. The other coil furnished covers the broadcast band of 200 to 550 meters. While a coil to cover the 100 to 200 meter band is available, it is not included as part of the unit.




**If you need a modulated radio-frequency oscillator for testing the tuning range of a receiver, or condenser, coil combination then the unit is connected according to the above circuit**

Types of tubes that will perform efficiently include the 226, 201A, 199, 112A, 222 and 224 screen-grids, and the high mu 240. Due to the extreme flexibility of the multi-unit it may be used with either a.c. or d.c. receivers.




**For an unmodulated radio-frequency oscillator the multi-unit is connected as shown here**

Perhaps even more fascinating than picking up short-wave programs and code messages is another use of the multi-unit. Assume that the receiver with which it has been working doesn't seem too efficient. If it is of the single-dial variety, the trouble may be that the radio-frequency stages are out of step, or in more technical terms, off resonance.

### *As Oscillator and Set-Tester*

What can the unit do about this? Why, a lot, if it is connected as a radio-frequency oscillator. Putting this in another way, it is made into a miniature broadcasting station. As such it sends out a modulated or unmodulated wave of controllable frequency to which a receiving set will respond, just as it does to programs in the air. The circuit used is shown in the diagram, Fig. 2.

With the dial of the oscillator adjusted to about midway of its scale, tune the receiver under test until a squeal or whistle is heard. This indicates that the oscillator is functioning.

Now attach one side of the .0001 mfd. fixed condenser furnished with the unit to terminal "G," along with the grid leak and condenser. Disconnect the antenna from the set, and run a wire with a spring clip to the free end of the condenser. Then attach the clip to the antenna post

of the set under test.

The tone of the oscillator will then be audible in the loud speaker. When it has been peaked carefully by tuning the receiver dial, make note of the scale reading. Then shift the clip from antenna post to the plate terminal of the first radio-frequency tube socket, retune the receiver, and again note the dial setting.

Repeating this process with each radio frequency stage, that one that is off resonance can quickly be detected, and correction made so that, regardless of the position of the clip, settings of the receiver dial are uniform.

Reversing the procedure just outlined, the oscillator can be calibrated by tuning the set to a known broadcasting station, then putting the oscillator in resonance with the receiver, and noting the oscillator dial setting.

Suppose that the station is WLW, Cincinnati, which broadcasts on 700 kilocycles, and that the oscillator dial reads 60. Then this setting will always correspond to 700 kilocycles, and stations in that channel will be picked up by tuning a receiver to the oscillator when its dial is at 60.

After several stations at various points in the broadcast band have been logged on the multi-unit when it is used as an oscillator, it will function as a wavemeter. And if a graph be prepared with its curve running through the plotted positions of these stations, the places at which others should come in can be determined quite accurately.

It might happen, for example, that a new receiver was being tried out for DX, and that its dial was not sufficiently accurate to make sure of KFI's presence or absence. With the oscillator set at 640 kilocycles and the receiver tuned to it, Los Angeles would be heard if within range, after the oscillator had been shut off.

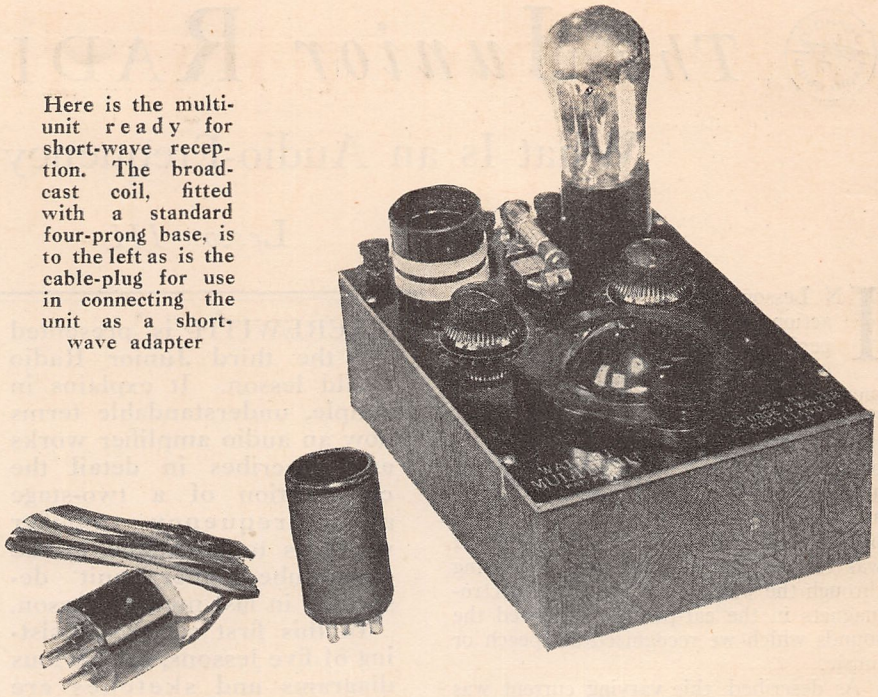
For portability and convenience, the unit can be powered as a radio-frequency oscillator by a 4½ volt "C" battery lighting the filament of a 199 tube, and a 22 or 45-volt "B" battery for plate supply.

Such are only two of the many uses for the radio-frequency oscillator into which this unit can be so easily converted.

Short-circuiting the grid leak and condenser, as shown by a dotted line in the diagram, Fig. 3, gives an unmodulated note for special purposes. Another range control is the fixed condenser that can be cut into or out of the tuning circuit.

The result of using the multi-unit as a pre-amplifier or booster with a broadcast set is, naturally, increased range, selectivity and volume. The device then serves as an additional stage of radio-frequency, with or without regeneration.

The operation is the very simple one of plugging into the first radio-frequency socket of the receiver, then tuning the unit dial with those of the set.



**Here is the multi-unit ready for short-wave reception. The broadcast coil, fitted with a standard four-prong base, is to the left as is the cable-plug for use in connecting the unit as a short-wave adapter**

## *A Handy R. F. Amplifier or Short-Wave Adapter*

Of particular interest is such employment of the multi-unit by owners of sets of the older vintage, with good amplifiers and speakers, but perhaps only a stage or two of radio-frequency instead of the three or four that are common now.

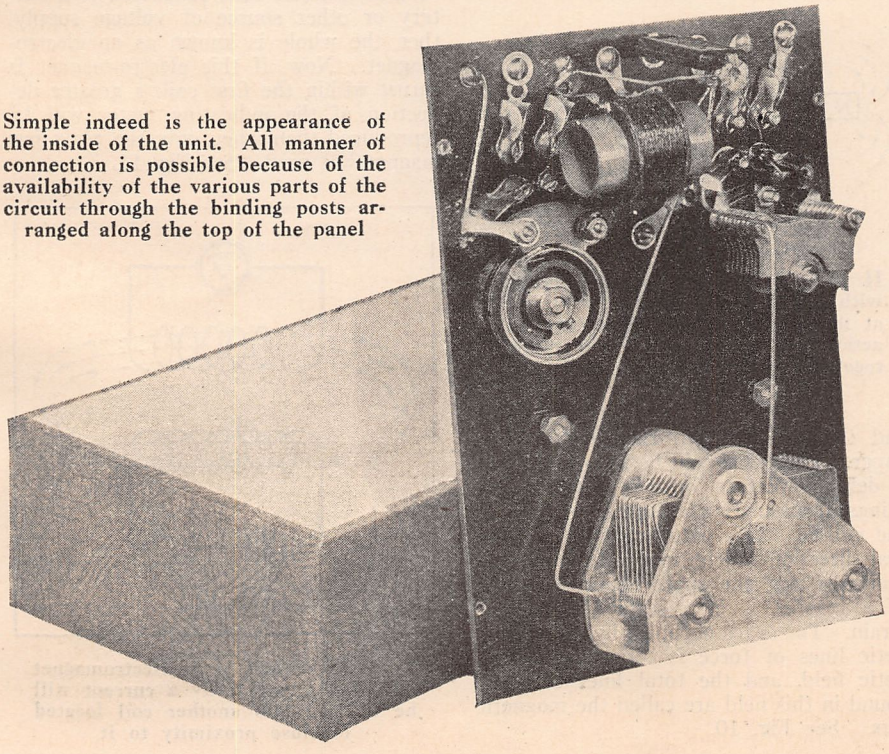
The logical thing, then, is to add a stage, and since putting it inside the cabinet would be difficult if not impossible, a small external unit that is easy to connect and tune is the thing. And the multi-unit makes use not only of standard radio-frequency tubes, but the more efficient screen-grid types as well. To facilitate the extra connection, a tube cap clip is provided.

Balancing to prevent oscillation is accomplished by means of a midget condenser. And the same instrument provides any degree of regeneration up to the "spilling" point. Thus the pre-amplifier can be kept "hot" at all frequencies.

Perhaps the owner of a broadcast set is troubled by broad tuning that permits locals to monopolize too much of his dial. With a multi-unit he has two remedies; either to use it as an additional radio-frequency stage, with a gain in selectivity, or to connect it as a wave trap in various ways. Tune the trap to the unwanted station, the set to the wanted one, and there you are.

Directions for using the unit cannot be given in detail here. But to illustrate the simplicity of connecting it in different ways, here are instructions for employing it as a short-wave adapter or converter with a direct current receiver.

"Connect red wire of adapter plug to binding post No. 7, black to No. 2, yellow to No. 6. Remove detector tube from receiver and insert in socket "T" of unit. Insert plug in detector socket of set. Remove antenna from set and connect to post No. 1. Fasten ground wire to post No. 2. All tuning is done with the dial of multi-unit.



**Simple indeed is the appearance of the inside of the unit. All manner of connection is possible because of the availability of the various parts of the circuit through the binding posts arranged along the top of the panel**

# The Junior RADIO Guild

## What Is an Audio-Frequency Amplifier?

*Lesson III*

IN Lesson No. 2 was described the action of detection or rectification performed by the detector tube and its associated circuits. It will be remembered from this previous lesson that the character of the incoming signal, composed of radio frequency alternations or oscillations, was changed, through the action of the detector tube so that a variation in the strength of the current in the plate circuit of that tube was produced. It was this varying current, which, passing through the windings of the small electro-magnets in the ear-phones, produced the sounds which we recognized as speech or music.

As described, this varying current was not of an alternating character, but was of a direct, pulsating character. That is, the current flowed constantly in one direction, the sound being produced through the medium of the 'phones by virtue of the changing, varying strength of this current. It is important to remember this, because it has a direct bearing on the following description of the theory of operation of an audio-frequency amplifier.

### *Magnetism and Electro-Magnetic Induction*

There are certain metals which possess the property of attracting to them scraps of iron or steel and are known as artificial magnets. A substance naturally possessing this property and found in the earth is known as lodestone, and if a bar of hard steel is rubbed with the lodestone the steel will become magnetized and is then an artificial magnet. Simple experiments will prove that the strongest force of attraction exists at the ends of the magnetized bar, and are known as the poles.

This stronger force which exists at the poles can be very well illustrated by placing a piece of paper over the bar magnet and then sprinkling iron filings on the paper. The filings will be seen to assume a definite pattern on the paper, more filings accumulating at the ends than at the middle. This pattern shows the general direction of the magnetic force and indicates that the space about the poles of a magnet is in a state of stress or strain. The space occupied by these magnetic lines of force is termed the magnetic field, and the total lines of force found in this field are called the magnetic flux. See Fig. 10.

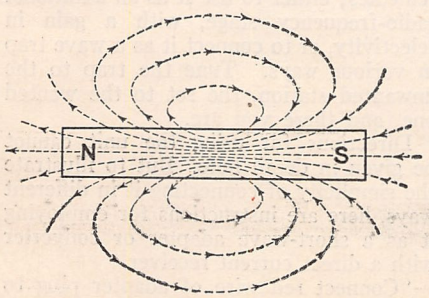



FIG. 10

**In a steel bar which has been magnetized, the lines of force, if they could be seen, would shape themselves into the pattern shown above. The arrowheads indicate the direction of flow of these lines of force**

**HEREWITH is presented the third Junior Radio Guild lesson. It explains in simple, understandable terms how an audio amplifier works and describes in detail the construction of a two-stage audio-frequency amplifier which is to be added to the single-tube tuner unit described in last month's lesson.**

**In this first series, consisting of five lessons, the various diagrams and sketches are consecutively numbered. Thus, the first figure in this, the third lesson, is Fig. 10.**

**To gain a comprehensive idea of the general construction of the five-tube receiver, part by part, it is well to compare the present lesson with its various sketches and photographs with those which have already been printed.**

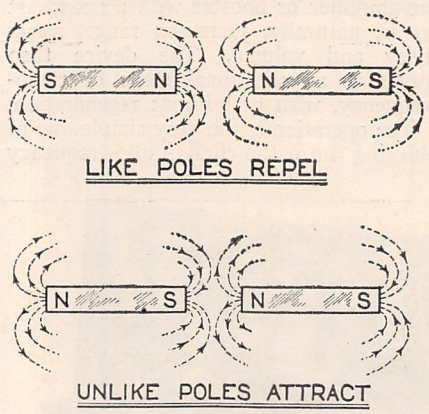



FIG. 11

**If two magnetized bars are placed with similar ends together, as shown at the top, there will be a repelling action; if unlike poles are placed together they will attract each other (bottom)**

Bars of steel so magnetized and left to swing freely or pivoted will point to the north magnetic pole, like the needle of a compass. The end which does point to the north is known as the north pole of the magnet, while the opposite end is the south pole.

Experiment will prove that if two magnetized bars of steel are brought close together, with the north pole of one near the north pole of the other, there will be produced a distinct repulsion. This is also true if both south poles are brought together. On the other hand, if a north and a south pole are brought near each other, there will be noticed a distinct attraction. This phenomenon gives rise to the observation that like poles repel, while unlike poles attract. See Fig. 11.

Now if we wind a coil of wire and attach to the two coil terminals some indicating device, such as a galvanometer or other sensitive meter, and then thrust the bar magnet within the coil, a movement of the needle on the indicating device will be noted. This movement or deflection is only momentary, the needle coming to its former zero position when the bar magnet is held stationary within the coil. When, however, the bar is withdrawn from the coil, another similar deflection of the needle is noted. What has happened is that the magnetic lines of force, or the flux of the bar magnet, in cutting across the turns of the coil, induced in the coil a current which caused the meter to indicate it.

If over the bar magnet is wound a coil of wire, with its ends connected to a battery or other source of voltage supply, then the whole is known as an electro-magnet. Now, if this electro-magnet is thrust within the first coil, a greater deflection of the indicating meter will be reproduced than when only the plain bar magnet was used. See Fig. 12.

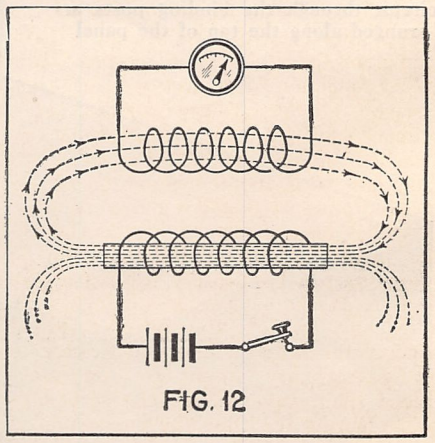


FIG. 12

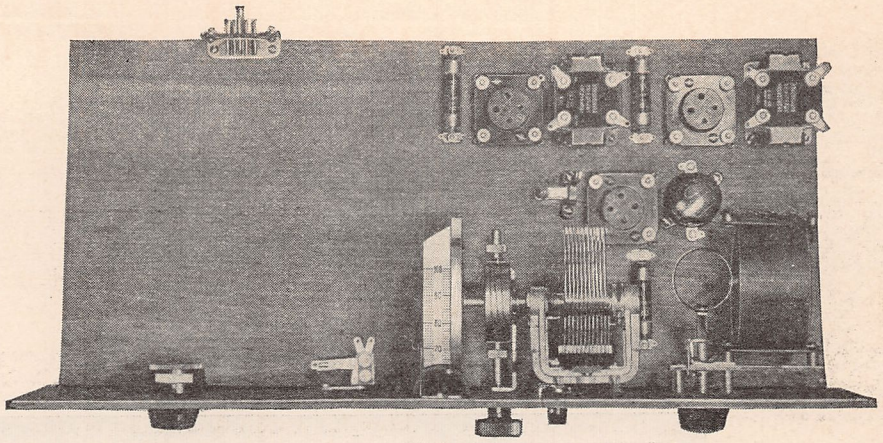
**When the circuit of an electromagnet is closed momentarily a current will be induced into another coil located in close proximity to it**

However, as before, the deflection will be caused only when the electro-magnet is actually being moved through the first coil, but not when it is at rest. From this it will be observed that a current indication is obtained only when the electro-magnet is moving through the coil, thereby inducing in it a current. When the electro-magnetic field surrounding the electro-magnet is stationary, then no current is induced in the second coil, but when the electro-magnetic field is in motion the magnetic lines of force or flux of the electro-magnet are acting upon the second coil, thus inducing therein a current.

Now the flux of the electro-magnet can be made to move in several ways. Either the electro-magnet itself can be made to move or rotate so that the lines of force which are set up cut through or cross the turns in the indicating coil, or the connection to the battery supplying voltage to the winding about the electro-magnet can be periodically opened and closed, thus causing the flux or magnetic field to rise and collapse about the electro-magnet.

This entire action can be amplified or more closely observed if a core be added to the existing apparatus. The core would then take the place of the bar magnet, the first coil being wound on one of the legs of the core, with the second or indicating coil being wound on another. This entire collection of apparatus would then resemble a transformer, consisting of a primary coil (the one with the battery attached to its terminals), a secondary (the one with the indicating meter attached to its terminals) and a core.

As has been explained, if the connection in the battery or primary circuit be closed, then a momentary reading or deflection on the indicating meter will be noted only for that fraction of a second which is taken by the lines of force set up by the primary circuit to completely thread their way through the secondary coil. During the time the connection is closed there will be no deflection of the indicating needle because the flux or lines of force are stationary. However, when the connection is opened, a deflection similar to the first will be noted.



Here is the JRG receiver with the two-stage audio channel added to the tuner, described last month

Below is given the complete schematic circuit diagram of the two-stage audio-frequency amplifier described in these pages

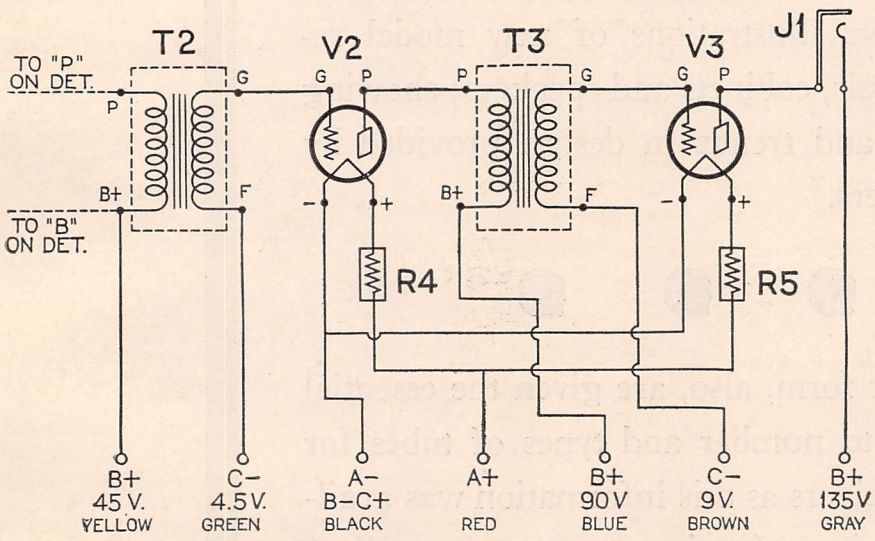



FIG. 13

### *The Audio-Frequency Transformer*

Now, if in place of the constant current flowing through the primary from the battery, a current varying in strength is applied to the primary circuit, then the electro-magnetic field set up by the primary will vary in accordance with the variations in the strength of the current flowing through the primary, thus causing a varying movement of the flux which is threading its way through the secondary.

Previously it was observed that when the connection to the battery circuit was closed, a deflection in one direction on the meter was noted, while when the connection was opened, the deflection was in the opposite direction. This was caused by the rising of the flux when the connection was closed, causing a deflection in one direction while when the connection was opened, thus allowing the flux or magnetic field to collapse, the current induced in the secondary was in the opposite direction, thus causing an opposite deflection. This rise and fall of current is quite important to remember, because it is necessary to keep it in mind when observing what is taking place when, instead of the make and break of the current by opening and closing the battery connection, a varying direct current is applied to the primary. What happens in this instance is that the varying flux set up by the primary circuit induces in the secondary circuit an alternating current of greater voltage than that originally found in the primary circuit. This step-up is caused by the fact that the secondary coil has many more turns than the primary; in fact, this step-up is a function of the ratio of proportion which exists between the primary and secondary. If the latter has five times as many turns as the former the ratio is said to be 5 to 1.

Observe now that after applying an alternating radio frequency signal to the grid of the detector tube and then rectifying or detecting it so that we could employ the audio frequency variations to actuate a pair of phones, we are now applying this pulsating direct current audio frequency signal to the primary of an audio transformer and obtaining at its secondary terminals an alternating current signal, enlarged by virtue of the amplifying characteristics of the step-up transformer. This alternating current signal cannot be compared to that originally absorbed by the antenna because the antenna signal was of a radio frequency or inaudible nature, while this which we now have is of an audio frequency or audible nature.

As a simple comparison, the action of the transformer in performing the task assigned to it can very well be likened to the cutting of a loaf of bread. You can have your bread, and even go so far as to place the knife upon it, but, unless you give motion to the knife, moving it backward and forward, there will be no cutting of the bread. It is the same with a transformer. You can have the two windings, the core, and the current in the primary circuit, but, unless this current is varying in nature to cause a setting up and collapsing of the magnetic field, there will be no current induced in the secondary circuit. When the current in the primary remains constant, then a stationary flux or magnetic field is set up, but no current is induced in the secondary.

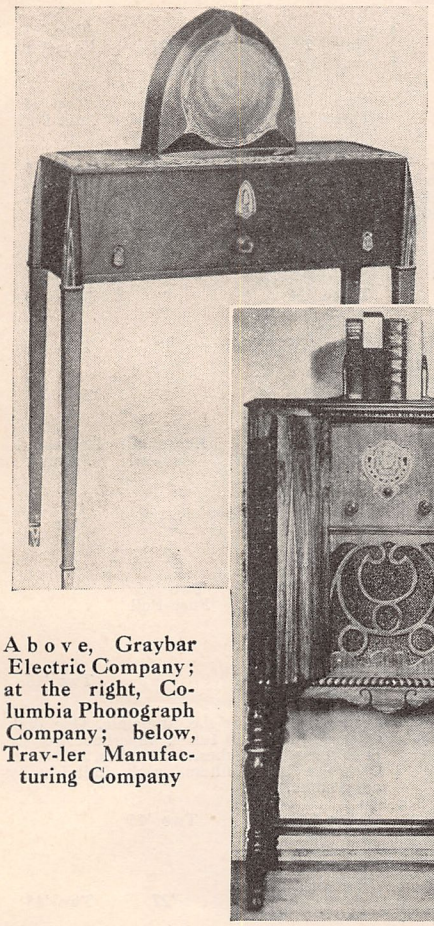
(*Continued on page* 354)

# 1930 Styles and Specifications for Receivers and Speakers

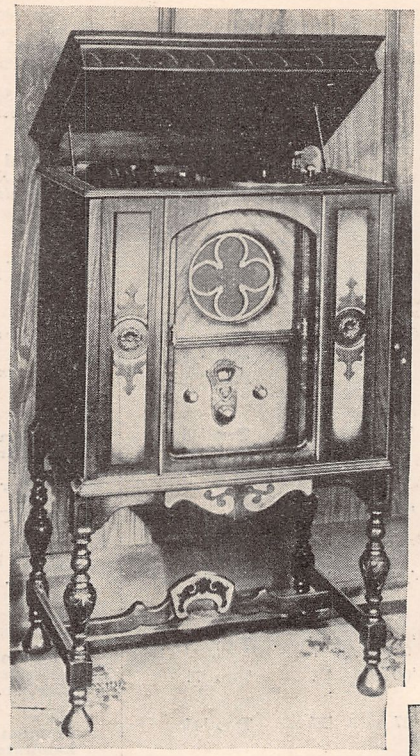
ON the following pages are grouped representative illustrations of new model receivers, chassis, cabinets and speakers; showing the variety and trends in design provided by manufacturers.

IN tabular form, also, are given the essential facts as to number and types of tubes for as many receivers as this information was available, at the time of going to press; as well as the characteristics of leading makes of loud speakers.

# 1930 Styles *and* Specifications *for* Receivers *and* Speakers

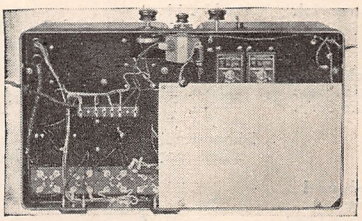


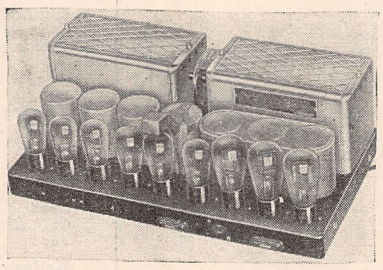
Above, Graybar Electric Company; at the right, Columbia Phonograph Company; below, Trav-ler Manufacturing Company

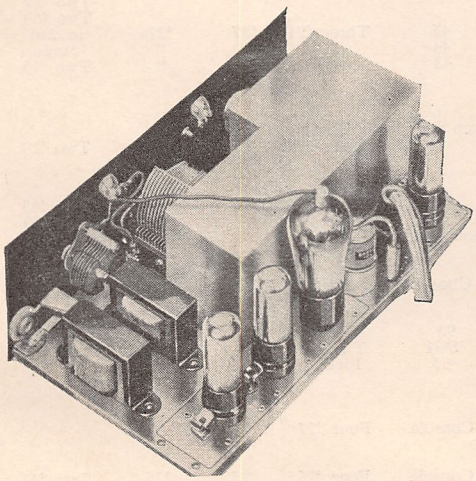


Above, Pierson Cabinet

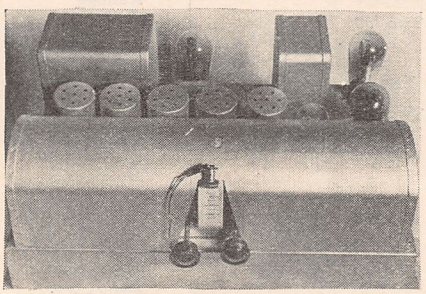
Above, Stromberg-Carlson Tel. Mfg. Co. console; below, Lafayette Duo-Symphonic

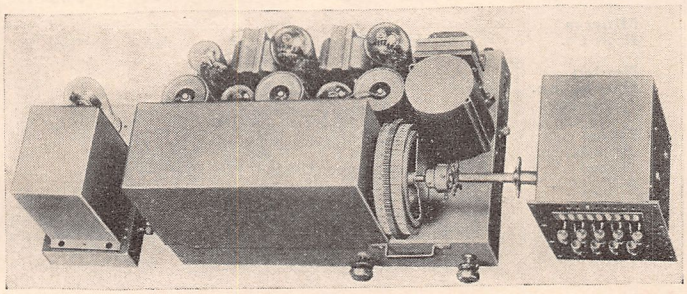


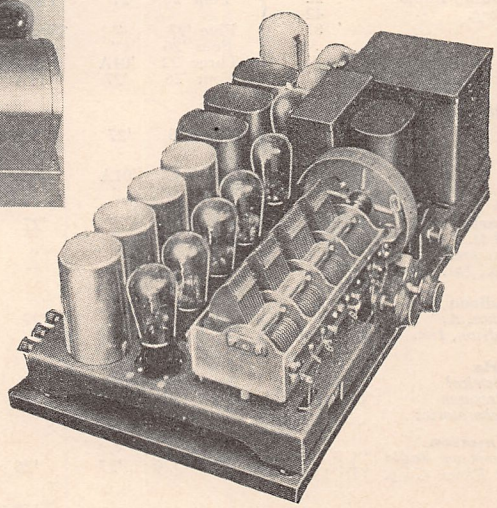




Center of page, top view of Lafayette Duo-Symphonic; immediately below, Balkeit chassis, Model C (Fansteel Products, Inc.); lower left corner, Zenith chassis with push-button tuning; directly below, Bremer-Tully chassis



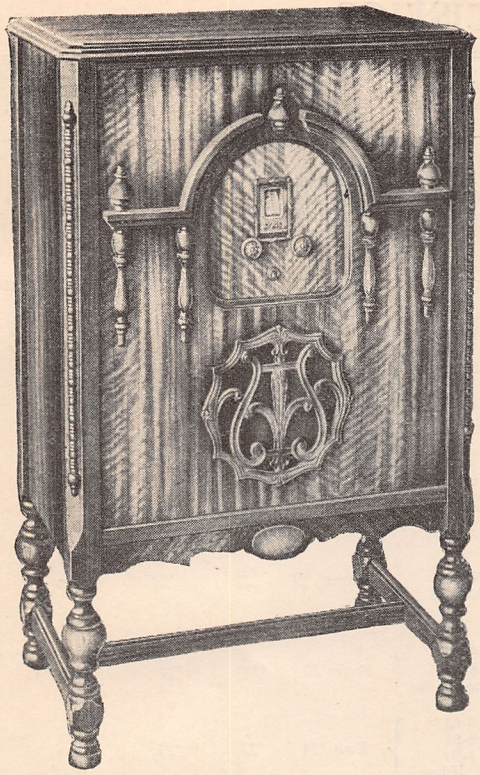


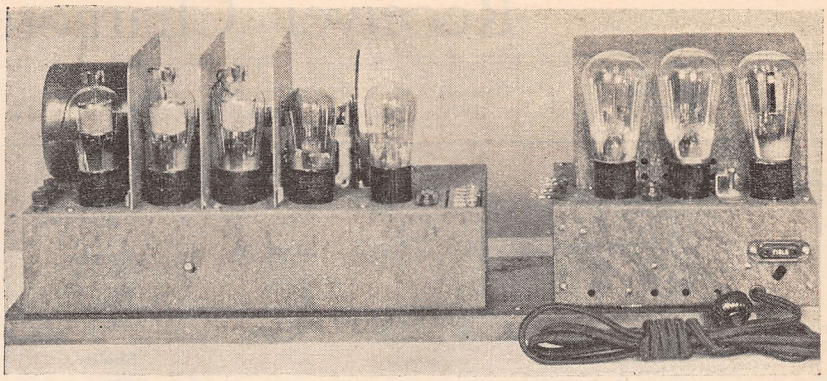


# Receiver Characteristics

| Manufacturer | Model Number | R. F. | DET. | 1st A. F. | 2nd A. F. |
|---|---|---|---|---|---|
| **A-C Dayton** *A-C Dayton Co.* | 98, 9960, 9970, 9990, 9100, 9980 | Five '27 | '27 | Two '45 | |
| **Acme** *Acme Elec. & Mfg. Co.* | 88 | Three '27 | '27 | '27 | Two '45 |
| | 77 | " | " | " | '45 |
| | Console | " | " | " | Two '45 |
| | A-C-7 | " | " | " | '71A |
| **Amrad** *American Radio and Research Corp.* | | Three '24 | '27 | '27 | Two '45 |
| **Apex** *U. S. Radio & Television Corp.* | No. 36 | Three '26 | '27 | '26 | '71 |
| | No. 50 | " | " | " | " |
| | No. 55 | " | " | " | " |
| | No. 89 | Four '26 | " | " | Two '71A |
| | No. 60 | Two '24 | " | '27 | Two '45 |
| | No. 70 | Three '24 | " | " | " |
| | Console | " | " | " | " |
| **Atwater Kent** *Atwater Kent Mfg. Co.* | 55 Screen Grid, Table | Two Screen Grid | '27 | '27 | Two '45 Push-Pull |
| | No. 55 Chassis | | | | |
| | Console | | | | |
| **Balkeit** *Fansteel Products, Inc.* | Console | Four '27 | '27 | '27 | Two '45 |
| | Chassis | Three '27 | " | " | " |
| **Bosch** *American Bosch Magneto Corp.* | 48 Table, Console, De Luxe | Three '24 | '27 | Two '45 | |
| **Brandes** *The Brandes Corporation* | B-10 | Three '27 | '27 | '27 | '71A |
| | B-11 | " | " | " | Two '45 |
| | B-12 | " | " | " | " |
| **Bremer Tully** *Chicago* | 81 | Three '27 | '27 | '27 | Two '45 |
| | 82 | " | " | " | " |
| | 80 | Three '01A | '00 | '01 | Two '71 |
| **Brunswick** | No. 14, No. 21, No. 31 | Three '27 | '27 | '27 | Two '45 |
| **Buckingham** *Buckingham Radio Corp.* | No. 6950, No. 2, No. 1, No. 3 | Four '26 | '27 | '26 | Two '71A |
| | Phono-Radio | | | | |
| | Phonograph | None | None | None | None |
| **Bush and Lane** *Bush & Lane Piano Co.* | No. 20, No. 21, No. 30, No. 32, No. 34, No. 40, No. 60, No. 50, No. 70, No. 90, Phono Radio | Three '27 | '27 | '27 | Two '45 |
| **Colonial** *Colonial Radio Corp.* | | Three '27 | '24 | '27 | Two '45 |
| **Continental "Star Raider"** | R-20, R-30, R-P-40 | Six Cardon Heaters | Cardon Heater | Two '50 | |
| **Crosley** *Crosley Radio Corp.* | 32, 22, 42 | Four '26 | '27 | Two '71 | |
| | 82 | Five '27 | " | Two '45 | |
| | 31 | Four '26 | " | '71A | |
| | 21 | Three '22 | '01A | '71 | |
| | 41 | Four '26 | '27 | '71A | |
| **Day Fan** | 68, 72, 69, 66 | Four '26 | '27 | '26 | Two '45 |
| | 73 | Four '01A | '01A | '01A | "12" |
| | Console | " | " | " | " |
| **Earl** *Chas. Freshman Co., Inc.* | No. 22 | Four '26 | '27 | '27 | Two '71A |
| | No. 32 | Four '27 | " | " | Two '45 |
| | No. 31 | " | " | " | " |
| | No. 41 | Five '27 | " | " | " |
| **Edison** *Thos. A. Edison, Inc.* | "R-4", "R-5", "C-4" | Three '27 | '27 | '27 | Two '45 |
| **Erla** *Eletrical Research Laboratories* | R2 Screen Grid | Three '26 Two '24 | '27 " | '26 " | Two '71A Two '45 |
| **Emerson** *Emerson Radio & Phono. Corp.* | "C" Console, "D" Console | Three '26 | '27 | '26 | Two '45 |

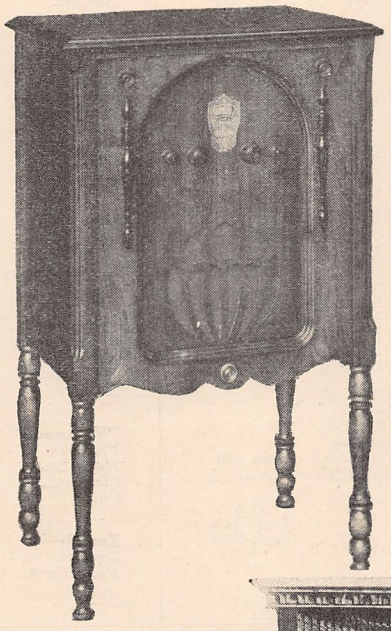
| Manufacturer | Model Number | R.F | DET. | 1st A. F. | 2nd A. F. |
|---|---|---|---|---|---|
| **Eveready** *National Carbon Co., Inc.* | No. 31, No. 32, No. 33, No. 34 | Three '27 | '27 | '27 | Two '71 Push-Pull |
| *New "40" Series with Two '45 Push-Pull* | 42, 43, 44 | Three '27 | '27 | '27 | Two '45 Push-Pull |
| *New "50" Series Screen Grid* | | Three '24 | '27 | '27 | Two '45 Push-Pull |
| **Federal** *Federal Radio Corporation* | L-36 | Three '24 | '27 | '27 | Two '45 |
| | L-46 | " | " | " | " |
| | M-41 | Three '27 | " | " | " |
| | M-46 | " | " | " | " |
| **Fada** *F. A. D. Andrea, Inc.* | 20 | Three '27 | '27 | '27 | Two '71A |
| | 25 | Two '24 | " | " | Two '45 |
| | 35 | " | " | " | " |
| | 75 | Three '24 | " | " | Two '10 |
| | 77 | " | " | " | " |
| **"Freed"** *Freed-Eisemann* | 55 | Four '26 | '26 | " | Two '71 |
| | 78, 79, 95 | Four '27 | '27 | '27 | Two '45 |
| **Gilfillan Bros., Inc.** | 100 | Four '27 | '24 | '27 Resistance Coupled | '45 Resonated Primary |
| **Graybar** *Graybar Electric Co.* | 311, 310, 320, 330, 340 | Three '26 | '27 | '27 | '71 |
| **Grebe Syncro-phase** *A. H. Grebe & Co., Inc.* | 270, 285, 450 | Three '24 | '27 | Two '45 Push-Pull | |
| **Gulbransen** *Gulbransen Piano Co.* | 291, 292, 295 | Four '26 | '24 | '26 | Two '45 |
| **High Frequency Laboratories Chicago** | Chassis | Feeds either a.c. or d.c. dynamic. One dial, one spot tuning, 10 tubes, Superheterodyne Four screen grid tubes, 4 '27 tubes, 2 '45 tubes Uses five tuned filters. each individually adjustable., | | | |
| **Howard** *Radio Co. Chicago* | | Four '26 | '27 | Two '45 | |
| **Kennedy** *Colin B. Kennedy, Inc.* | 310, 210 | Three '27 | '27 | '27 | Two '45 |
| **Kolster** *Kolster Radio Corp.* | 45 | Three '24 | '27 | '27 | Two '27 Two '50 in 3rd Stage |
| | 44 | " | " | " | |
| | 43 | " | " | " | Two '45 |
| **Seven Seas** *C. R. Leutz Inc.* | Seven Seas | Three Screen Grid | '27 | '27 | Two '10 |
| **Kellogg** *Kellogg Switchboard & Supply Co.* | 523 | Three '24 | '27 | '27 | Two '45 |
| | 524 | " | " | " | Two '50 |
| | Phono Radio | " | " | " | " |
| **"National"** | Chassis | Four '27 | '27 | '27 | Two '45 |
| **Lyric** *All-American Mohawk Corp.* | 93 | Five '27 | '27 | Two '27 | Two '45 |
| | SG1 | Three '24 | " | Push-Pull | Push-Pull |
| | 95 | Five '27 | " | " | " |
| **Majestic** *Grigsby Grunow Co.* | Console | Four '27 | '27 | Two '45 | |
| **McMillan** *Radio Corp.* | Console | Four '26 | '27 | '26 | Two '45 |
| **Minerva** *Radio Co.* | Console | Three '27 | '27 | '27 | Two '45 |
| **Norden Hauck, Inc.** *Philadelphia* | | Five '24 | '27 | '27 | Two '45 |
| **Philco** *Philadelphia Storage Battery Co.* | 65, Low Boy, Hi Boy, De Luxe | Two Screen Grid | '27 | Two '45 Push-Pull | |
| | Hi Boy | " | " | '26 | Two '45 |
| | Lo Boy 87 | Three '26 | " | " | Push-Pull |
| | Hi Boy 87 | " | " | " | " |
| | De Luxe Hi Boy 87 | " | " | " | " |

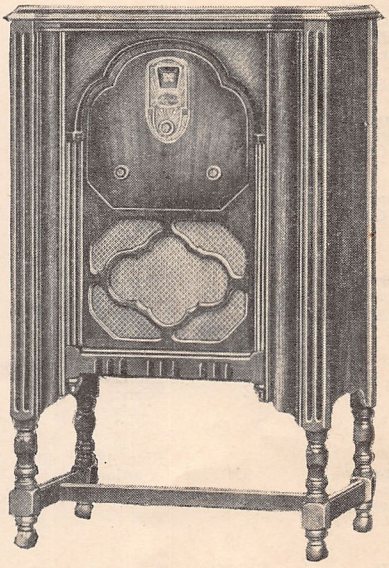


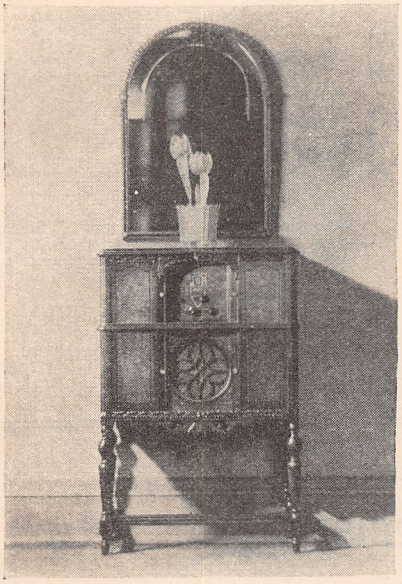


Above, Eveready chassis (National Carbon Company); at the left, the Lyric Radio (All-American-Mohawk Corporation)

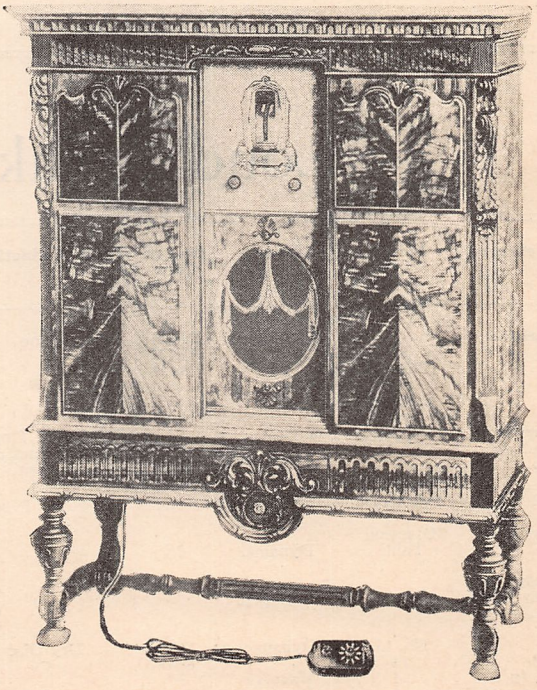
Below, the new Majestic Radio (Grigsby-Grunow Company)

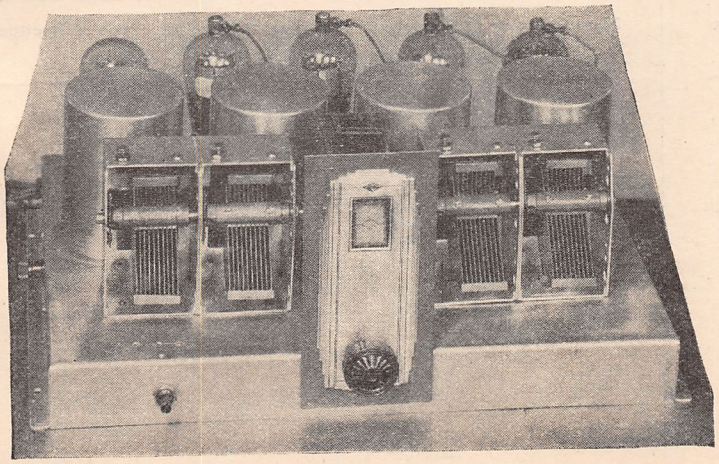






Above, Roemer Radio (Rudolf Roemer Furniture Company); at the left, a Bosch console radio (American Bosch Magneto Corporation)





The MB-29 (The National Company)

New Zenith model with remote-control tuning

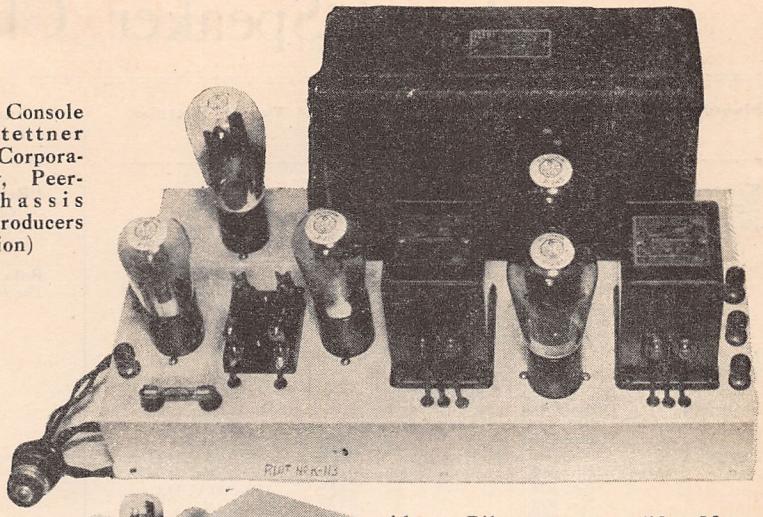
# Receiver Characteristics

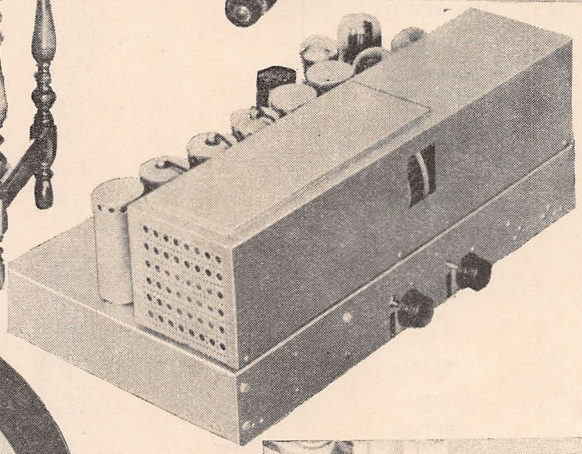
| Manufacturer | Model Number | NUMBER AND TYPE OF TUBES R. F. | Det. | 1st A. F. | 2nd A. F. |
|---|---|---|---|---|---|
| **Premier** *Premier Elec. Co. Chicago* | "2930-7-M" "2930-7-D" R-53 R-57 R-55 R-54 R-47. | Three '27 | '27 | '27 | Two '71 |
| **Pierce Airo** *New York* | 45 46 | Three '26 | '27 | '27 | Two '45 |
| *Radio Products Laboratory* **"RPL"** | 4AC 3AC Phono-Radio | Three '26 | '27 | '26 | '26 |
| **Pierson** *The Pierson Co., Rockford, Illinois* | No. 71 | Three '27 | '27 | '27 | Push-Pull '71 |
| **Radiola** *Radio Corp. of America* **"Radio Victor"** | 44 46 | Two '24 | '24 | '24 | '45 |
| **Silver** *Silver Marshall, Inc.* | 60 95 30 | Three '24 | '24 | '27 | Two '45 |
| **Shamrock** *Shamrock Mfg. Co.* | Console | Two '27 One '24 | '24 | '27 | Two '45 |
| *Sentinel Mfg. Co.* | 555 444 440 550 | Four '26 Two '24 " Four '26 | '27 " " " | '26 " " " | Two '45 " " " |
| **Sonora** *Sonora Phonograph Co.* | 34 | Three '24 Three 15-volt Sonora | Power '27 | Two '45 | |
| | No. 30 No. 32 No. 40 | Tubes " " | " " " | '27 " " | Two '45 " " |
| | No. 36 No. 44 | Four 15-volt Sonora Tubes " | " " | " " | Two '50 " |
| **Sparton** *Sparks-Withington Co.* | 931 | Five 484 Cardon | 484 Cardon | Two 182-B Cardon | |
| | 301 | " | " | Two 250 Cardon | |
| | 110 | " | " | Two '26 Push-Pull | Two 250 Push-Pull |
| **Steinite** *Steinite Mfg. Co.* | No. 261 | Three '26 | '27 | '26 | '71A |
| | No. 40 | " | " | " | Two '71A Push-Pull |
| | No. 45 | " | " | '27 | " |
| | Phono-Radio | " | " | " | " |
| **Sterling** *Sterling Mfg. Co.* | A-2-60 B-2-60 | One '24 Two '27 Three '24 | '27 " | '27 " | Two '45 " |
| **Simplex** *Simplex Radio Co. Sandusky, Ohio* | Louis XV5 | Four '27 | '27 | '27 | Two '45 |
| **Shelby** *Shelby Mfg. Co. Trenton, N. J.* | 52 H-42 H-32 | Three '27 | '27 | '27 | Two '45 |
| **Stromberg-Carlson** *Stromberg-Carlson Tel. Mfg. Co.* | 641 642 | Three Screen Grid | '27 | '45 | |
| **Stewart-Warner** *Stewart-Warner Corp.* | 90 No. 35 No. 58 | Three '27 | '27 | '27 | Two '45 |
| **Temple** *Temple, Inc.* | 8-60 8-80 Phono-Radio | Four '27 | '27 | '27 | Two '45 |
| **"Temple"** *Screen Grid Radio* | 8-61 8-81 8-91 Radio-Phono | Two '24 | '27 | '27 | Two '45 |
| **"Peerless"** *United Reproducers Corp., Peerless Division* | 21 22 23 24 | Three '24 | '27 | '27 | Two '45 |
| **"Courier"** *United Reproducers Corp. Arborphone Div.* | 65 651 652 653 | Three '24 | '27 | Resis. Coup. '27 | Two '45 |
| **"Victoreen"** *Victoreen Radio Co. Cleveland, Ohio* | Console | (One tuned r.f. '27, 1 oscillator '27, first detector '27, 3 i.f. '27, second detector '27, first audio '27, second audio '50, two voltage reg. tubes, two '81 rectifiers, one '01A tube, "C" rectifier. Superheterodyne.) | | | |
| **Zenith** *Zenith Radio Corp.* | 42 41 | Three '27 Four '27 | '24 " | '27 " | '10 '71A |

# Loud Speaker Characteristics

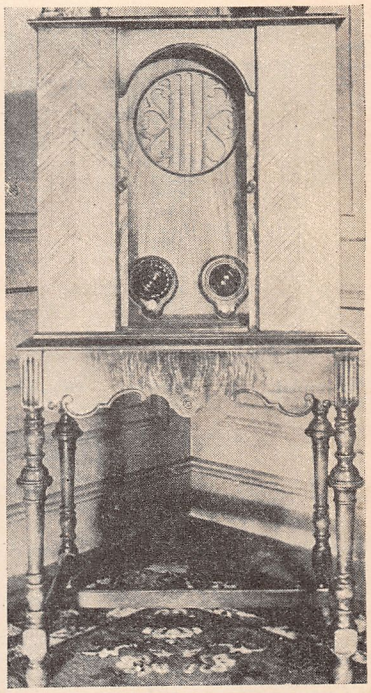
| Manufacturer | Model | Type | Size of Cone | Type of Rectifier |
|---|---|---|---|---|
| **Air-Chrome** | G | Magnetic | 24x26 | None |
| | M | " | 18x23 | " |
| | Theatre | " | 24x24 | " |
| | Manufacturer's | " | 12" | " |
| **Atwater Kent** *Atwater Kent Mfg. Co.* | F-4 | Dynamic | | 250 Volts Through Power Pack on Chassis. |
| **Best** *Best Mfg. Co.* | "Theatre Dynamic" | Dynamic | "Oversize" | Two '81 Tubes |
| **Crosley** | "Dynacoil" Table | Dynamic | 7" | |
| **Eveready** *National Carbon Co., Inc.* | No. 6 | Dynamic | 7" | '80 |
| **Fada** *F. A. D. Andrea, Inc.* | No. 15 | Dynamic | 7" | Dry Disc |
| | 14 | " | 8½" | " |
| | 4 | Magnetic | 7" | |
| | 6 | Dynamic | | " |
| **Farrand** *Farrand Mfg. Corp.* | Chassis | "Inductor Dynamic" | 7" | None |
| | " | " | 10" | " |
| | Cabinet | " Regular | 7" | " |
| **Farrand** *Farrand Mfg. Corp.* | Chassis | Dynamic | 7" | Dry Disc |
| | " | " | 10" | " |
| | " | " | " | '80 |
| | " | " | 7" | D.C. Field |
| | " | " | 10" | " |
| | " | Magnetic | 7" | |
| | Small Baffle | " | " | |
| | Box Chassis | " | " | |
| | Clock Cabinet | " | " | |
| | Gothic Cabinet | " | " | |
| **Graybar** *Graybar Electric Co.* | Table Model | Magnetic | 7" | None |
| | Console Model | Dynamic | " | |
| | 33 | | | |
| **Jensen** *Jensen Radio Mfg. Co.* | Concert | | 10" | Tube |
| | D7 A.C. | Dynamic | " | High Res. Field |
| | D7 D.C. | " | " | 220 V. D.C. |
| | D7 D.C. | " | " | 6 V. D.C. |
| | D7 D.C. | " | | |
| | Imperial | " | " | Tube |
| | " | " | " | High Res. Field |
| | " | " | 12" | Tube |
| | " | " | " | High Res. Field |
| | Auditorium | " | " | Tube |
| | " | " | " | High Res. Field |
| | " | " | " | 110 V. D.C. |

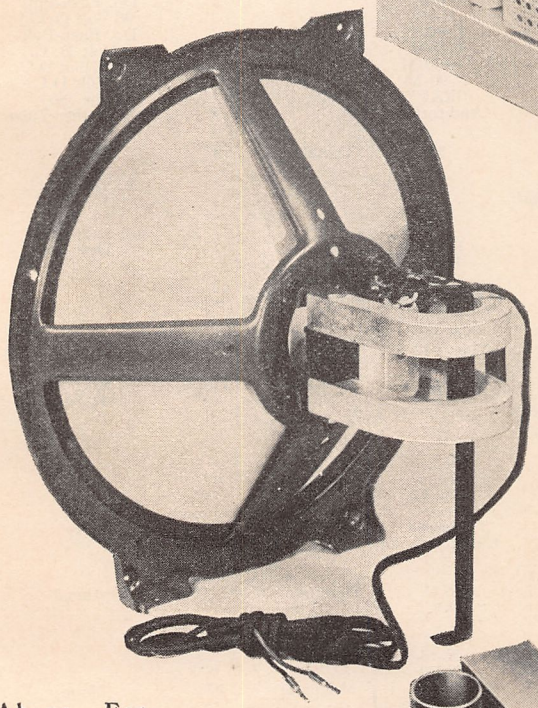
At the left, Console cabinet (Stettner Phonograph Corporation); below, Peerless radio chassis (United Reproducers Corporation)

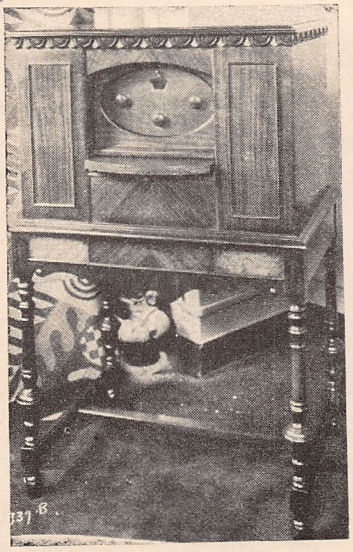




Above, Pilot power amplifier No. K113

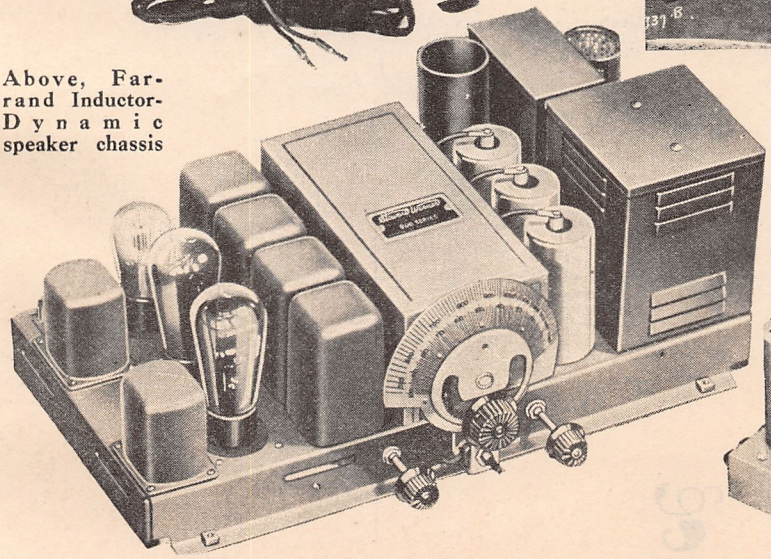


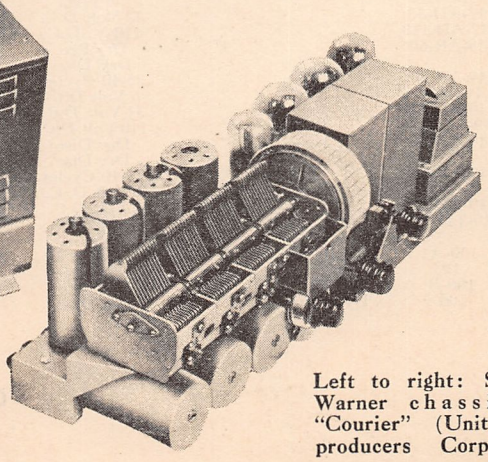




Above, Superior Cabinet Corp. console for Atwater Kent; at the left, the new Ware radio console (Ware Manufacturing Company)

Above, Farrand Inductor-Dynamic speaker chassis



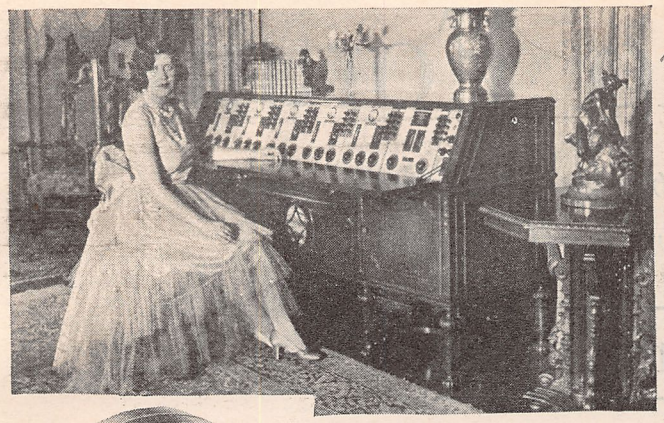


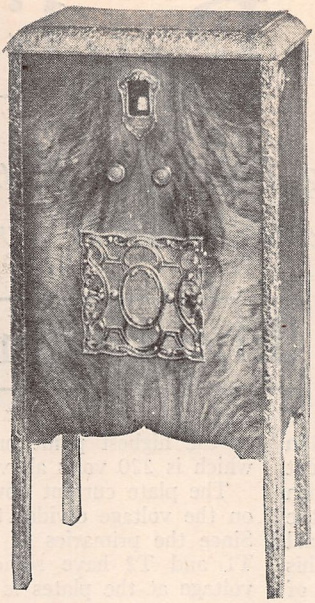
Left to right: Stewart-Warner chassis, and "Courier" (United Reproducers Corporation)

# Loud Speaker Characteristics

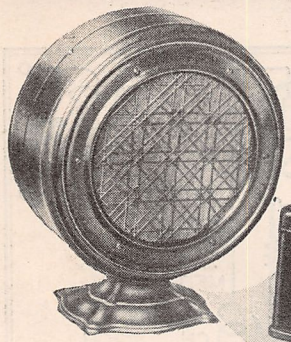
| Manufacturer | Model | Type | Size of Cone | Type of Rectifier |
|---|---|---|---|---|
| **Kersten** | D-221 | Dynamic | 8″ | Dry Disc |
| *Kersten* | M-120 | Magnetic | 9″ | None |
| *Radio Equip.Co.* | D-C-33 | Dynamic | 8″ | 100-120 Volt D.C. |
| | D-C-44 | " | " | 6 Volt to 220 Volt |
| | No. 4 | " | " | D.C. Field— |
| | | | | Dry Disc |
| | No. 2 Cabinet | Magnetic | 9″ | None |
| | No. 3 Cabinet | Dynamic | 8″ | Dry Disc |
| | Kersten Grand | Magnetic | 9″ | None |
| | KerstenCabinet | " | " | " |
| **Magnavox** | | | | |
| *The Magnavox Co.* | Carillon | Cabinet Only | | |
| | Aristocrat | " | | |
| | Stratford | " | | |
| | Campanile | " | | |
| *Speakers* | No. 106 | Dynamic | 7¾″ | 110-190 V.D.C. |
| | No. 107 | " | 10½″ | " |
| | No. 108 | " | 7¾″ | 180-300 V. D.C. |
| | No. 109 | " | 10½″ | " |
| | No. 200 | " | 7¾″ | 6-12 V. D.C. |
| | No. 201 | " | 10½″ | " |
| | | | | 105-120 V. A.C. |
| | No. 400 | " | 7¾″ | Dry Rectifier |
| | No. 401 | " | 10¾″ | " |
| | | | | 105-120 V. A.C. |
| | No. 402 | " | 7¼″ | Dry Rectifier |
| | No. 403 | " | 10¾″ | " |
| **Muter** | | | | |
| *Leslie F. Muter Co.* | 4310 For 110 V. 60 cycles. | Dynamic | 9″ | '80 Tube |
| | 4311 For 110 V. 25 cycles. | " | " | " |
| | 4410 For D.C. 90 volt, 2300 ohms, 40 M. A. drain. | " | " | " |
| | 4390 | " | " | None |
| | 4306 | " | " | " |
| | For D.C. 6 volt 4411 | " | " | '80 Tube |
| | 4490 | " | " | None |
| | 4406 | " | " | " |
| | 4510 | " | " | '80 Tube |
| | 4511 | " | " | " |
| | 4590 | " | " | None |
| | 4506 | " | " | " |
| **Nathaniel** | D-29 | Dynamic | 9″ | Dry Disc |
| *Baldwin* | " | " | " | 110-120 Volt D.C. 2500 to 5000 Ohms |
| | E-29 | Electronetic | " | D.C. |
| | 29 | Magnetic | 7″ | |
| **O'Neil** | 33-A | Dynamic | 9″ | Dry Disc 110 V.A.C. |
| *O' Neil Mfg. Co.* | 25-D | " | " | 110 Volt D.C. |
| | 29-D | " | 12½″ | " |
| **Operadio** | 2106 | Dynamic | 9″ | 110 Volt D. C. |
| *Operadio Mfg. Co.* | | | | 110 V. A. C. |
| | 2306 | " | " | Tube Rec. |
| | Conamic | Magnetic | 11½″ | " |
| | Parisienne | " | " | " |
| | St. Charles | Dynamic | 9″ | 110 V. D.C. |
| | Jack Horner | " | " | 110 V. D.C. |
| **Oxford** | | | | |
| *Oxford Radio Corp.* | 35, 34, 33, 32, 31 | Dynamic | 10″ | Tube Rec. |
| | 43 | " | 8″ | " |
| | 23 | " | 8″ & 10″ | Dry |
| **Philco** | Mantel | Dynamic | 10″ | Tube Rectifier |
| **Quam** | C | Magnetic | " | None |
| **Peerless** | 17-AR-60 | Dynamic | 7″ | Dry Disc |
| | 17-AR-30 | " | " | 25-40 Cycle |
| | 17-AD-6 | " | " | 6 Volt |
| | 17-AD-32 | " | " | 32 Volt D.C. |
| | 17-AD-110 | " | " | 110 V. D.C. |
| | 19-AR-60 | " | 9″ | Dry Rec. |
| | | | | Dry Disc |
| | 19-AR-30 | " | " | 25-40 Cycles |
| | 19-AD-6 | " | " | 6 Volt D.C. |
| | 19-AD-32 | " | " | 32 Volt D.C. |
| | 19-AD-110 | " | " | 110 Volt D.C. |
| | 19-TR-60 | " | " | Dry Disc |
| | | | | Dry Disc |
| | 19-TR-30 | " | " | 25-40 Cycles |
| | 19-TD-6 | " | " | 6 Volt D. C. |
| | 19-TD-32 | " | " | 32 Volt D.C. |
| | 19-TD-110 | " | " | 110 V. D.C. |
| **Radiola** | 100-A | Magnetic | 7″ | |
| *Radio Corp. of America* | 103 | " | " | |
| | 100-B | " | " | |
| | 106 | Dynamic | 8″ | Dry Disc |

| Manufacturer | Model | Type | Size of Cone | Type of Rectifier |
|---|---|---|---|---|
| **"Reproduco"** | R-10 A.C. | Dynamic | 9″ | Dry Disc |
| *Operators Piano Co.* | R-90 | " | " | None |
| **Rola** | J-6 | Dynamic | 7⅝ | 6 Volt D.C. |
| *The Rola Co.* | | | | 6 Volt D. C. |
| | J-6-2 | " | " | With Push-Pull Tr. |
| | J-90 | " | " | 90 Volt D. C. |
| | J-90-2 | " | " | Do. With Push-Pull Trans. |
| | J-110 | " | " | Dry |
| | J-110-2 | " | " | Do. Push-Pull Trans |
| | J-180 | " | " | 150-225 V. D.C. |
| | J-180-2 | " | " | Do. Push-Pull |
| | J-160 | " | " | 5000 Ohm D.C. |
| | J-2 | " | " | Do. Push-Pull |
| | J-6-M | " | " | Six Volt D.C. |
| | J-90-M | " | " | 90 Volt D.C. |
| | J-160-M | " | " | 5000 Ohm D.C. |
| | J-180-M | " | " | 150-225 V. D. C. |
| | J-90-L | " | " | Dry Westinghouse |
| | 30-J | " | " | None |
| | 15 | Magnetic | | " |
| | 20 | " | | " |
| | "M" | " | | " |
| | | | | Westinghouse |
| | C-110 | Dynamic | 9″ | Dry Disc |
| | C-110-2 | " | " | Do. Push-Pull |
| | C-6 | " | " | Transformer |
| | | | | 6 Volt D. C. |
| | C-6-2 | " | " | 6 V. D.C. Push-Pull |
| | C-180 | " | " | 150-225 V. D.C. |
| | C-180-2 | " | " | Do. Push-Pull |
| | C-90 | " | " | 90 Volt D. C. |
| | C-90-2 | " | " | Do. Push-Pull |
| | C-6-M | " | " | 6 Volt D. C. |
| | C-180-M | " | " | 5000 Ohm D.C. |
| | C-90-M | " | " | 90 Volt D.C. |
| | "RAC" | " | 12″ | Tube (80) |
| | Auditorium | " | 9″ | '80 Rectifier Tube |
| **Silver** | 851 | Dynamic | 9″ | (80) |
| **Marshall** | 841 | " | " | 90 Volt D. C. |
| *Silver-Marshall Inc.* | | | | |
| **Sterling** | R-13-C | Dynamic | 7″ | Dry Disc |
| | R-250 | Dynamic | | * |
| | DYN Amplifier | Speaker Amplifier Only | None | |
| **Stewart-Warner** | No. 441, No. 442 | "Dyphonic" | 7″ | None |
| **"Symington"** | Chassis | Dynamic | 7½″ | '80 Tube |
| *Valley Appliances, Inc.* | " | " | 10″ | '80 Tube |
| **Temple** | | | | |
| *Temple, Inc* | No. 5 | Magnetic | 9″ | None |
| | No. 17 | Magnetic | 54″ | " |
| | | Air Column | Air column | " |
| | Chassis | Dynamic | 9″ | Dry |
| | Cabinet Model | " | " | " |
| **"T. C. A."** | | | | |
| *Transformer Corporation of America* | A. C., D. C. | Dynamic | 9⅜″ | Optional |
| **Utah** | X-15, X-20, "M", "B" | Magnetic | 9″ | None |
| *Utah Radio Products Co.* | Dynalo Cabinet | Dynamic | " | Dry Disc. |
| | " | " | " | 110 V. D. C. |
| | " | " | " | None |
| | 65 | " | " | Dry Disc |
| | " | " | " | 110 V. D. C. |
| | " | " | " | None |
| | 33-A | " | " | Dry Disc |
| | 43-D | " | " | 110 V. D. C. |
| | 53-R | " | " | None |
| | Stadium 66-A | " | 12¼″ | |
| | Stadium 76-D | " | " | |
| | | | | Dry Disc |
| **Wright-de Coster** | 107 | Dynamic | 10″ | 25-60 Cycle |
| *Wright-De-Coster, Inc.* | 107-T | " | 12″ | " " |
| | 108 | " | " | " " |
| | 108-T | " | " | " " |
| | Wood Horn No. 9 | Horn Only | 48″ long Bell 30″ x21½″ | None |
| | Wood Horn No. 5 | | 48″ long Bell 23″ x22″ | " |

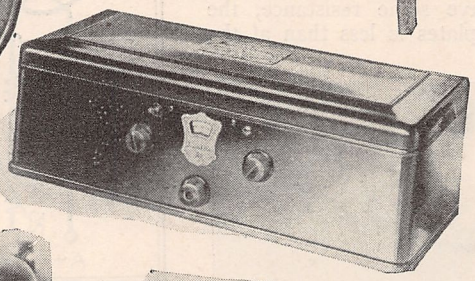


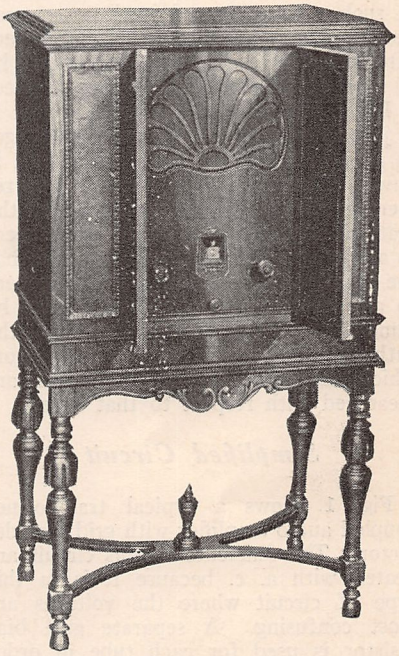


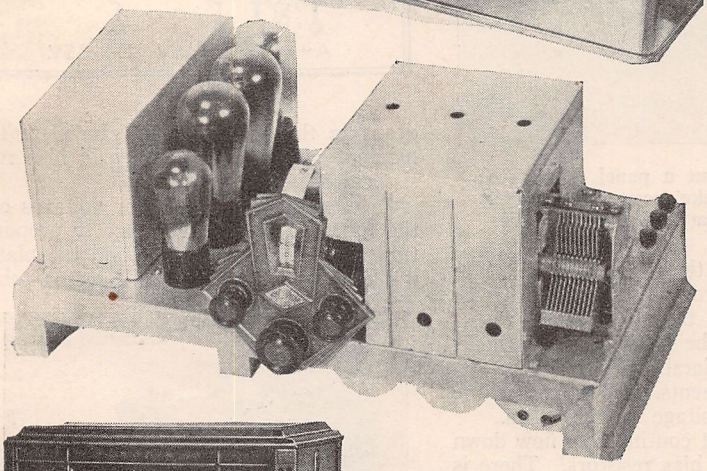
Above, Crosley model 43S (Crosley Radio Corporation); at the left, Sterling Mfg. Company Console



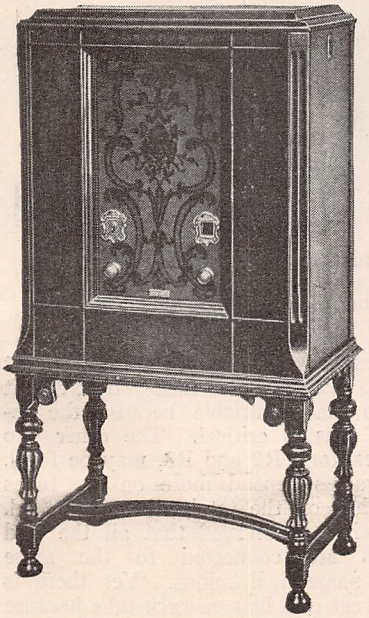
Above, Silver Ghost receiver (C. R. Leutz, Inc); below, Atwater Kent table model set and speaker



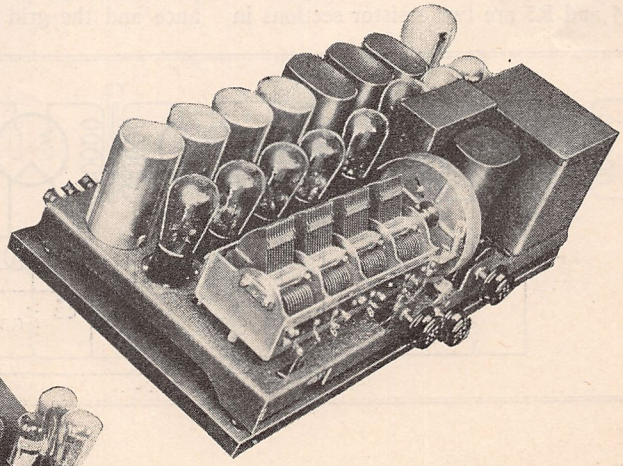


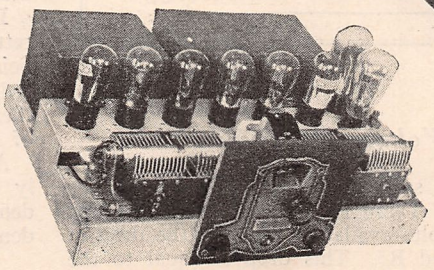


Above, Silver - Marshall chassis No. 722; at the right, above, Fada Highboy (F.A.D. Andrea, Inc.); below, chassis of the Metrodyne receiver



Above, R. C. A. superheterodyne (Radio-Victor Corporation)





Above, chassis of Brunswick Radio (Brunswick-Balke, Collender Co.)

# The Radio Forum

*A Meeting Place for Experimenter, Serviceman and Short-Wave Enthusiast*

## The Experimenter

Students of radio receiver circuits often ask how it is possible to provide different grid bias voltages on various tubes when the grid returns are all connected to the same point, namely, the negative terminal of the B battery eliminator. That this question, says Mr. J. E. Anderson, of New York City, should be confusing is no wonder, for often the circuits are drawn in such a complex and intricate manner that even one well versed in the subject often must analyze the circuit before he is sure of the various voltages applied.

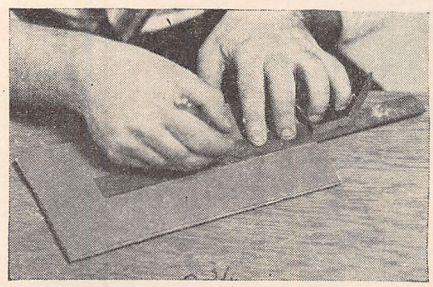
But a circuit may be drawn so that it is just as easy to tell the various voltages as it is to tell which is up and which is down. It is then only necessary to remember that the positive terminal on the plate voltage supply is up with respect to any other point in the circuit, and that the negative terminal is down with respect to any chosen point. It should also be remembered that the filament or the cathode of any tube is the point from which the plate and grid voltages are measured with respect to that tube.

### *Simplified Circuit*

Fig. 1 shows a typical transformer coupled audio amplifier with grid bias detector. The filaments of this circuit are heated with a. c. because it is in this type of circuit where the voltages are most confusing. A separate grid bias resistor is used for each tube in order to more clearly show the voltages.

R4 and R5 are two resistor sections in the B battery eliminator voltage divider. Only three of the binding posts on the eliminator are shown. The plate returns of the first two tubes go to the 135 volt point on the voltage divider, the voltage being measured from B minus. The plate return of the power tube is connected to the highest point on the eliminator, which is 220 volts above B minus.

The plate current flows from the taps on the voltage divider toward the plate. Since the primaries of the transformers T1 and T2 have some resistance, the voltage at the plates is less than at the B plus end of the transformers. The current flows from the plates to the cathodes. Since there is a high resistance between the plate and cathode, there is a considerable voltage drop between these elements. This drop is the effective plate voltage on the tubes.



**When laying out a panel, base, etc., be sure to make accurate markings by means of a scriber and square**

But the current continues to flow down through the grid bias resistors. There is an additional drop in them and this drop is the grid bias. The drop in the resistance R5 is equal to the drops in the primaries, the plate to cathode resistance and the grid bias resistors.

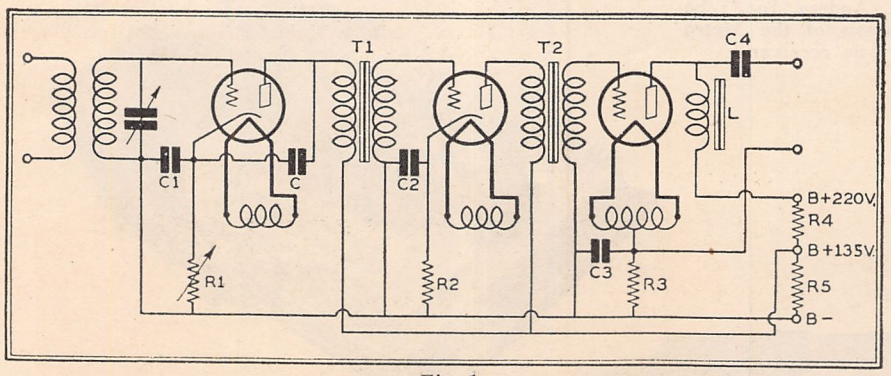



Fig. 1

### *Voltages in Power Tube*

The same thing happens in the power tube. There is a total voltage drop of 220 volts available, which is the drop in R4 and R5. This drop is equal to the drops in the choke coil L, the plate to filament resistance and the grid bias resistor R3.

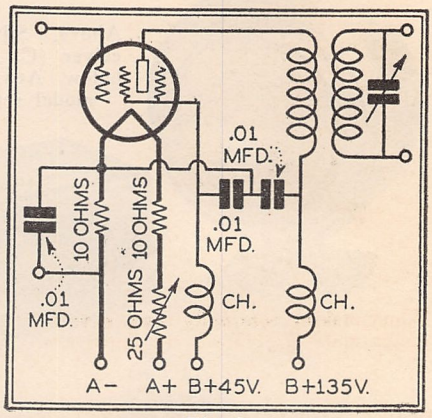
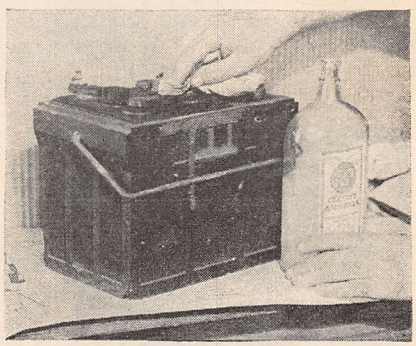



Fig. 2

In order to get the proper voltages on the tubes, it is only necessary to proportion the grid bias resistors and the plate resistances properly. The detector tube requires a high negative bias for best results. Hence R1 is made large, and it is also made variable because the required bias is critical. The other two bias resistors, R2 and R3, may be fixed. The values depend more on the tubes used than on the total voltages applied.



**Keeping the cell covers and terminal posts of a storage battery clean by means of an ammonia wash lengthens the battery's useful life**

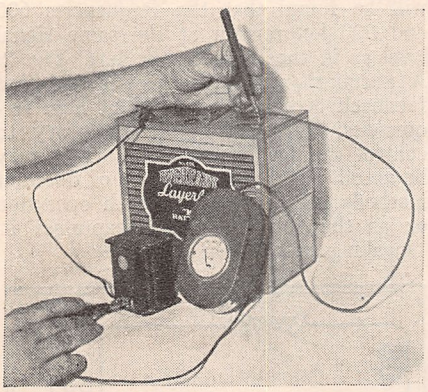
It will be observed that all the grid returns are connected to the same point, namely, B minus. Yet there is a different grid bias on each tube because there is a different voltage drop in each of the resistors, R1, R2 and R3.

Another problem that arises frequently is the connection of by-pass condensers. When possible all by-pass condensers should be connected from the

(*Continued on page* 360)

# The Serviceman

"Many times," says Mr. D. A. Brown, of Marion, Ohio, "the serviceman and the set builder run across small fixed condensers on which there is no capacity marking and also when he would like to know the capacity of various components of a set. A simple device for determining this can be constructed at a maximum



**When making continuity tests, a voltmeter and "B" battery are important items**

cost of $9. The device employs the capacity bridge principle, similar to that used in the laboratory test equipment. Our capacity bridge uses either the common a. c. or an audio oscillator for a resonance indicator.

The connections are shown in Fig. 1. In order to place the bridge in operation it is first necessary to balance it perfectly. This is done by inserting a fixed condenser of .001 mfd. as C1. This condenser should be of a high grade mica insulation type. By listening in on the phones

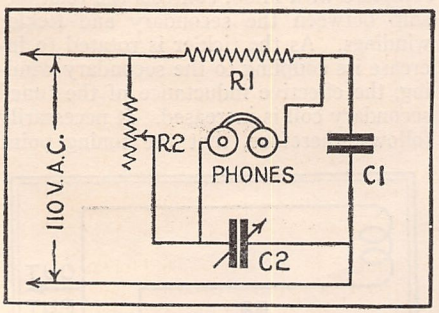



Fig. 1

and varying the resistance R2 and the condenser C2 the a. c. hum can be entirely eliminated. The bridge is now balanced and the resistance R2 should be left in this position permanently. All future adjustments are made with C2. When the hum disappears (resonance point) C2 will be practically at maximum. Now our capacity bridge is ready for testing unknown capacities. Remove the condenser C1 which we use only for preliminary adjustments, and in its place insert the condenser to be tested. Then vary dial on C2 until the a. c. hum disappears. At this point the dial setting of the condenser C2 indicates the capacity of the condenser under the test. C2 being of a straight line capacity type and equipped with 0 to 100° dial, the capacity of the condenser under test may be read directly from the dial set. In other words, if the a. c. hum disappears at 50° on the C2 dial, then the condenser on test is half of the standard or .0005 mfd. A dial reading of 25 would be .00025 mfd, or the condenser on test and the dial reading would be ¼ of the maximum capacity of the standard. A parallel or series group on condensers may be tested in this circuit providing of course the unknown capacity is not below the minimum or above the maximum of the standard C2. A 25 watt lamp is inserted in the 110 volt a. c. line, to limit the current in case one of the condensers on test

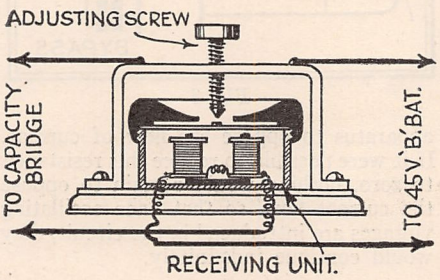



Fig. 2

breaks down. If the condenser is shorter the lamp will glow very red and if condenser is open it will be impossible to balance the circuit. For the average experimenter the 110 volt a. c. line will serve as a good resonance indicator, but better and sharper results may be had if the 110 volts a. c. line is replaced with an audio oscillator or microphone hummer. A microphone hummer is shown in Fig. 2. This hummer is made up from an old receiver or loud speaker unit.

Mr. Brown has also devised a method of obtaining a field supply for the dynamic speaker testing. This tester, as

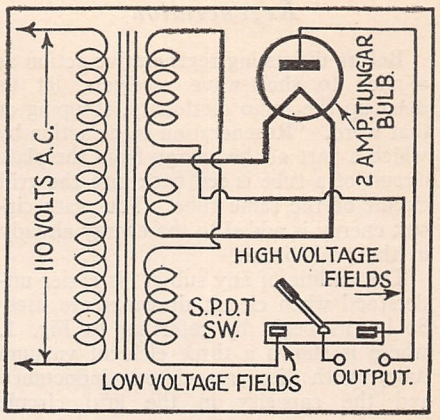
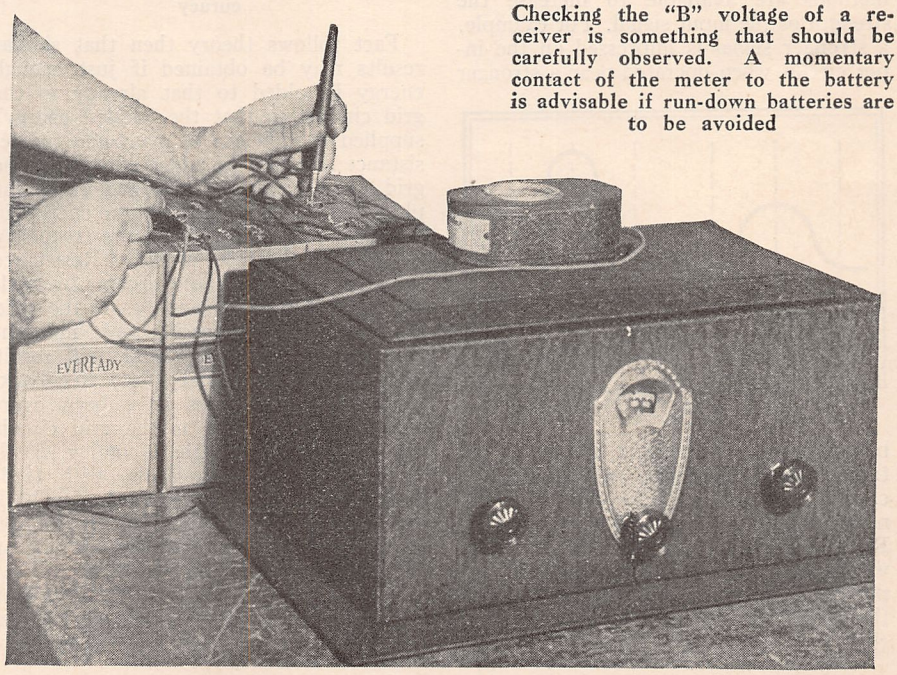



Fig. 3

shown in Fig. 3, saves considerable time when a speaker is brought in for repairs and the field supply system has been left on the job. As the bringing into the repair station the filed supply system, would mean dismantling quite a portion of the set equipment. A battery charger of the tungar type is used as a current supply for making tests. The output of this type of charger is usually around 6 volts for "A" battery charging. This will furnish the field current for the low voltage excitation of the field coil. The high voltage tap on the charger used to charge "B" batteries supplies around 100 volts which will also furnish the field current for the high voltage type of dynamic speaker. A small single pole double throw switch, shown in Fig. 3, allows a ready method of changing the voltages. A charger so equipped has been used in service work by myself with considerable satisfaction and for the repair man who likes current supply in compact unit this furnishes a reliable source which, when not used for this type of work, can be used for its specific purpose of charging batteries.




**Checking the "B" voltage of a receiver is something that should be carefully observed. A momentary contact of the meter to the battery is advisable if run-down batteries are to be avoided**

# On Short Waves

### *Regeneration*

Before discussing regenerative action as applied to short-wave receivers, let us open up the radio dictionary, stopping at that word. "Regeneration is the action by which a part of the energy from the plate circuit of a tube is fed back into the grid circuit of the same tube. The plate circuit energy is added to the energy already in the grid circuit.

The outline of any subject is easier understood when circuit drawings are used So let us begin by referring to Fig. 1, where is shown a three element vacuum tube, with its associated inductance and the capacity in the grid circuit

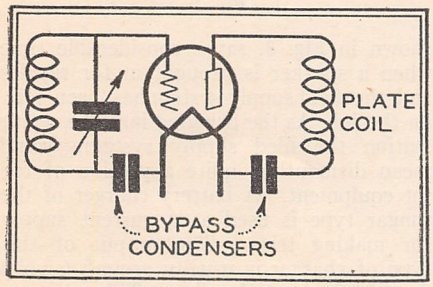



Fig. 1

and inductance in the plate circuit. The grid portion of this circuit is known as the input circuit of the tube, and the plate portion as the output circuit. The impressed signal on the grid circuit and the voltage changes in the signal cause corresponding voltage changes on the grid of the tube. These varying voltage changes on the grid of the tube, control the flow of a greatly magnified current in the plate circuit. Therefore, the strength of the output energy in the plate circuit is directly proportional to the impressed voltage on the grid of the tube. It necessarily follows that if the signal strength is increased at the input of the circuit, greater current flow will result in the output circuit. Of course, many methods are available to increase the strength of the input signal. For example, a stronger signal is impressed on the input circuit when operated near a stronger

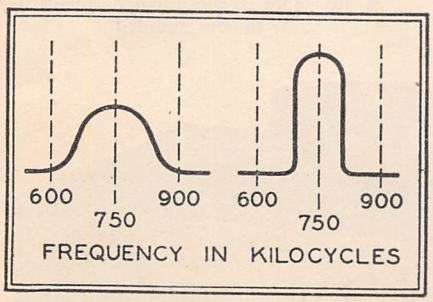



Fig. 2

broadcaster than from a distant, weak transmitter. However, we cannot all change our location to be near or in the neighborhood of a powerful transmitter. Regeneration then comes to our aid, whereby the regenerative action is employed to obtain a material increase in the input voltage applied to the input circuit.

When the grid circuit of a detector tube is tuned to resonance with the frequency of the incoming signal, the inductive reactance and the capacitive reaction in this circuit neutralize each other, leaving only the resistance of the associated

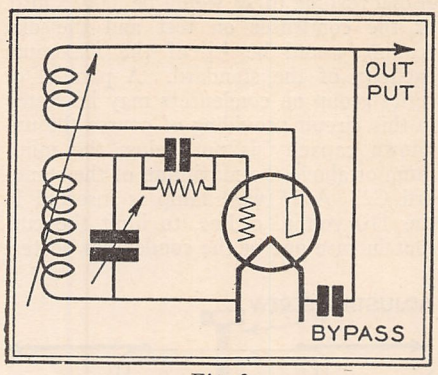
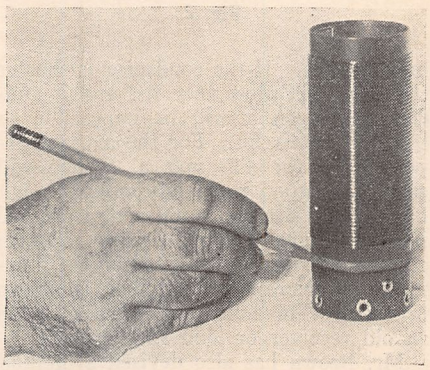



Fig. 3

apparatus to oppose the flow of current. If it were possible to reduce this resistance to zero, nothing would remain to oppose the current flow, so that once oscillating voltages are introduced in the circuit, they would continue indefinitely.



**Fixed coupling between secondary and tickler coils makes it possible to calibrate detector tuning circuits with a fair degree of permanency and accuracy**

Fact follows theory then that similar results may be obtained if just enough energy is added to that already in the grid circuit, so that the "added energy" supplied is sufficient to overcome the resistance losses. The added energy for the grid circuit may be obtained from the plate circuit as the maximum energy in the plate circuit is at the same frequency as that of the grid circuit. Resistance losses can therefore be overcome by feeding back the plate energy to the grid circuit. Sustained oscillations, independent of the incoming signal, will result with slight additional plate feedback, after resistance losses have been overcome. Just so long as the grid circuit absorbs energy from the incoming signal, is the tube in regeneration, with feedback in use. However, when the feedback is increased beyond this point, oscillation occurs, and will be sustained as long as the filament and plate supply last.

It will be seen that with the proper amount of regeneration that a weak signal can be built up materially. Thus, regeneration increases the sensitivity of the circuit as well as the selectivity.

In Fig. 2 the curve at the left graphically shows the side band of a receiver tuned at 750 kc. where the losses have not been overcome, while the curve at the right is "with regeneration." Since regeneration occurs at only the frequency to which the grid and plate circuits are tuned, it will be found that the frequencies 600 and 900 kc. remain at the same signal level as in the curve at the left. Fig. 2. A peculiarity with regeneration is that feedback occurs more easily at high frequencies. It is therefore necessary to control the feedback energy. This may be accomplished by a number of different methods, all providing smooth operation or as the short-wave fan expresses it. "sneaking up."

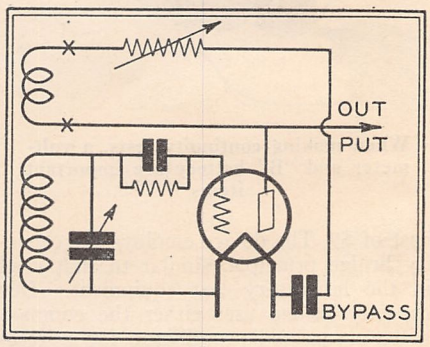



Fig. 4

Most generally used is the rotating tickler method shown in Fig. 3. The tuned secondary winding is wound on a stationary form and the tickler on a form slightly smaller in diameter than the secondary. This tickler rotates within the secondary winding. An extension shaft, complete with knob, controls the relationship between the secondary and tickler windings. As the tickler is rotated to increase its coupling to the secondary winding, the effective inductance of the tuned secondary coil is increased. It necessarily follows, therefore, that the tuning point

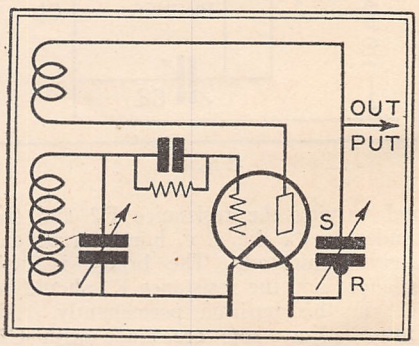



Fig. 5

at which the circuit resonates to a specified frequency will change with changes of the tickler adjustment. These changes produce a rather serious disadvantage in that the tuning circuit cannot be logged unless, of course, the dial reading for the tickler is noted as well as that of the secondary tuning circuit. When the voltages of the secondary and tickler coils are

(*Continued on page 373*)

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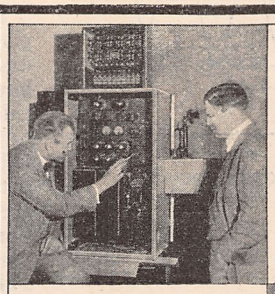

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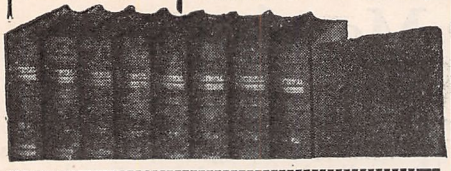

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| 32x4 | 5.95 | 6.95 | 1.25 | 30x4.50 | 4.90 | 5.90 | 1.25 |
| 33x4 | 5.95 | 6.95 | 1.25 | 31x4.95 | 6.90 | 7.90 | 1.25 |
| 34x4 | 5.95 | 6.95 | 1.25 | 30x5.25 | 6.90 | 7.90 | 1.25 |
| 32x4½ | 6.95 | 7.95 | 1.50 | 31x5.25 | 6.90 | 7.90 | 1.25 |
| 33x4½ | 6.95 | 7.95 | 1.50 | 30x5.77 | 6.90 | 7.90 | 1.50 |
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(*Continued from page* 341)

Like the knife, the magnetic field must be made to move before it can accomplish its work.

### *Audio Frequency Transformers and What They Consist Of*

There are many styles and types of audio frequency transformers available today, but essentially they are alike in that they consist of a primary winding, a secondary winding, and a metallic core.

The most common type employs a core consisting of many layers of sheet metal, usually silicon steel, which are termed laminations. These laminations have three legs jutting out from a common side much like the letter "E."

The primary winding consists of many thousands of turns of fine wire wound on a spool or insulated tube, large enough in inside diameter so that it may readily be slipped over the center leg of the laminated core.

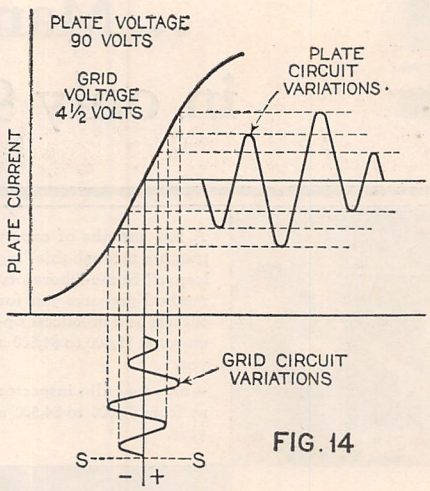


FIG. 14

**Due to the amplifying action of the tube a weak signal impressed on the grid is enlarged or magnified in the plate circuit**

The secondary coil is wound directly over the primary coil, being separated from the latter by several layers of insulating cloth. This secondary consists of many more turns than the primary, and is usually wound with a finer wire. The number of turns by which the secondary is increased over the primary depends upon the ratio desired between the windings. If a transformer is rated at 3 to 1 or 5 to 1, then the secondary will have three times as many turns as the primary in the first instance and five times as many in the latter instance.

The coil assembly consisting of the primary and the secondary windings has its center hole filled with a pile of laminations, half with the legs of the "E" facing in one direction and the other half facing in the other. The laminations are inserted one by one, the direction of the legs being faced alternately in one direction and then the other. When the core center has been filled, the laminations are clamped at the ends by straps of metal to prevent their working loose. Then the entire unit is enclosed in a metal can which acts as a shield so as to prevent the magnetic field of one transformer from intercoupling with an adjacent one. Suitable terminals are mounted on the shield can and insulated therefrom.

For details concerning the assembly of a transformer, see Fig. 15.

### *How the Audio Frequency Amplifier Tube Works*

A glance at the amplifier circuit, Fig. 13, will show that the terminals of the secondary coil of the first audio frequency transformer are connected to the grid and filament of the succeeding tube. The filament connection is made through the C battery lead which terminates at that particular value of C voltage which is required for the type of tube employed. Normally, first stage amplifier tubes require from 3 to 4½ volts of C battery to make them function satisfactorily. This C bias, as it is called, adjusts the tube to its correct operating characteristics and insures that, provided the proper amount of filament and plate voltage are employed, the tube will function successfully.

In Fig. 14 is shown the grid voltage-plate current characteristic curve of a first stage amplifier tube and indicates how the applied signal is amplified or enlarged through the amplifying action of the tube. It will be observed that unlike the characteristic curve for the detector tube, shown in Lesson No. 2, the signal is applied to the straight portion of the curve instead of the bended portion as in the case of the detector. Following the action through the tube,

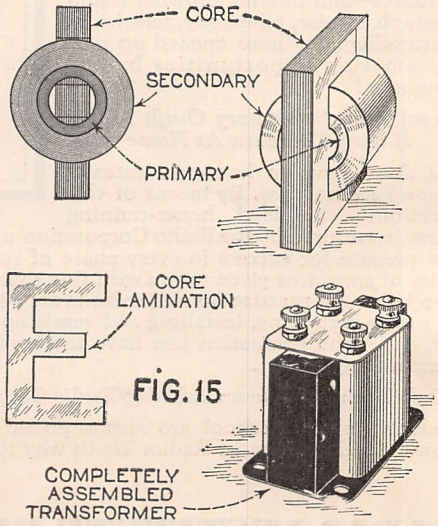


FIG. 15

**An audio-frequency transformer in principle is much like the electro-magnet illustrated in Fig. 12. Two coils, a metallic core and a shell comprise the entire unit**

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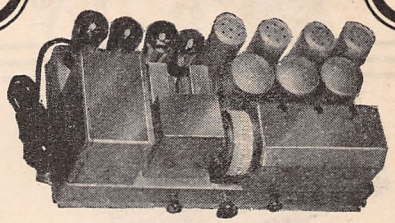

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it will be seen that the applied signal, indicated by the line S . . . S at the bottom of the figure causes a great variation in the plate current and in general enlarges the entire pattern of the applied signal, the while not changing its character.

As in the case of the detector tube, the electrons emitted by the hot filament are attracted to the plate which is of positive polarity. When a positive alternation of the applied signal reaches the grid, the attraction of the electrons toward the plate are aided. If the positive alternation be great, then a great amount of plate current will flow. If the positive alternation be not so great, then a lesser amount of plate current will flow. When a negative alternation reaches the grid of the tube it retards the flow of electrons to the plate, thus causing a falling off in the plate current. If the negative alternation be great, then correspondingly the falling off will be great. If the negative alternation be small, then the falling off will be correspondingly small.

Here, then, we have the same action or results which were produced in the plate circuit of the detector tube. The application of an alternating current to the grid of the tube releases currents in the plate circuit of varying amounts or strengths.

The action between the first audio frequency tube and the second amplifying tube is essentially the same as that just described, the difference being that in the plate circuit of the second audio stage is connected the loud speaker, which is more or less an enlarged or overgrown version of the head phones first used in the plate circuit of the detector stage.

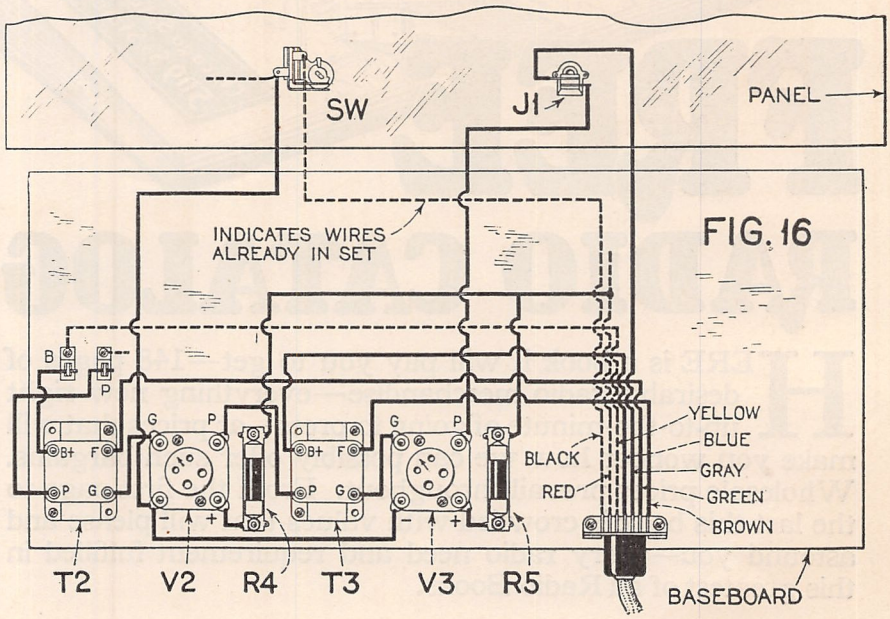
### *How to Construct a Two-Stage Audio Frequency Amplifier*

The parts used in the assembly and construction of the audio amplifier are two Thordason 3½ to 1 audio transformers, two sockets and two type 1A amperites. It is recommended that the reader obtain these parts and then proceed as follows:

First, study the photographic illustration on page 341 and the parts wiring diagram, Fig. 16, on separate sheet. Note the position of the transformers, the sockets and the amperites. Then temporarily place these parts on the baseboard of your receiver, getting them in approximately the same position as that shown in the photograph. To do this you may have to remove the two Fahnestock clips, which were previously used to take the phone tips.

In locating these parts on the baseboard as shown, it is important that the individual units be placed so that their terminals coincide with the layout as shown on the separate sheet.

Looking over the top of the panel towards the rear edge of the baseboard




**The picture wiring diagram of the audio channel should be compared with the circuit diagram, Fig. 13, for a clear understanding of the connections which are to be made**

the transformers should be placed so as to have their "Pos. B" and "Plate" terminals to the right side and the "Neg. Fil." and "Grid" to the left.

The sockets should be placed so that the two filament terminals are towards the back, while the grid and plate terminals are to the front. The mounts for the amperites may simply be placed alongside the left side of the sockets.

The position of the new parts should be compared with and aligned with those parts already mounted on the baseboard, such as those for the detector unit. For instance, it will be noted that the amperite for the second audio stage is directly in line with the drum dial. Likewise, the amperite for the first audio stage is directly in line with the "plate" post or terminal of the detector tube socket. The right edge of the first audio transformer is almost flush with the edge of the baseboard, while the second audio transformer is directly behind the de-

(*Continued on page* 366)

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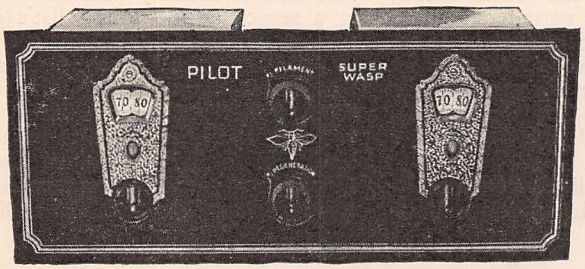


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## The Personality Behind the Ghost Hour

(*Continued from page* 317)

It is entirely mechanical, yet plays chess and checkers, draws selected cards, and acts lifelike in various other uncanny demonstrations. To the writer's knowledge, it is the only automaton in the world that is governed exclusively by mechanical action. Through the kindness of Beatrice Houdini, Dunninger also became the possessor of a large array of spiritualistic records, photographs, and various psychic data, which had been compiled by the late Houdini in his many years of research.

As an author, this man ranks among the foremost in work pertaining to the mystic. Among the books that he is accredited with, are *Universal Second Sight, Tricks Deluxe, Tricks Unique, Popular Magic (Volumes One, Two and Three), Houdini's Spirit Exposés, and Dunninger's Psychic Investigations.*

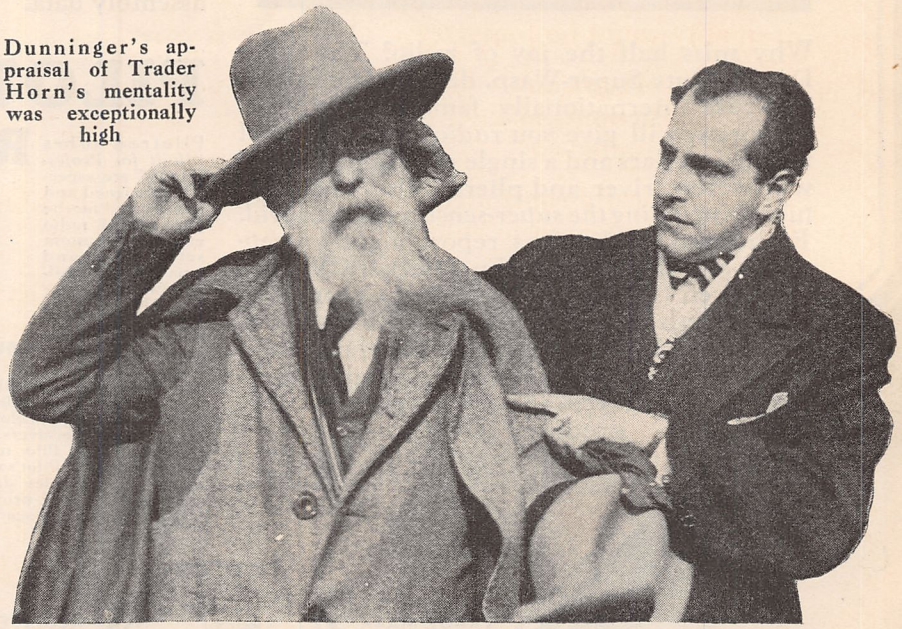
For years this mentalist has been chairman of the Scientific Investigation Committee of *Science and Invention Magazine,* which publication has a standing reward of $21,000, payable to any medium in the world who is capable of presenting any effect in so-called spiritualism or psychic phenomena which Dunninger would be unable to duplicate by natural or scientific means. Needless to say, hundreds of mediums have applied for this prize, but to date none has been able to offer sincere evidence of psychic ability when subjected to the searching eyes and keen analysis of this investigator.

One of the greatest mediums of all time, in the personage of Nino Pecoraro, a young Italian materializing medium, became a subject of Dunninger's investigation, and succeeded in presenting a most impressive seance, in which much of a spooky and uncanny nature was produced. Dunninger, however, easily duplicated all of the medium's wares under similar conditions, and produced much of a phenomenal nature, by scientific means, which even the medium could not produce by his self-styled spirit power.

It is amusing to find how many of the various magazines devoted to spiritualism have been offering accounts of Dunninger's work, and insisting that he is possessed of "spiritualistic power" which he does not in the least admit. Dunninger's scientific demonstrations and constant analysis of the things he does, seems to have absolutely no bearing upon their repeated opinion.

The investigator's daring and fearless attitude might be well expressed in the fact that he recently ventured to appear at a seance at the spiritualist's convention, in New York, and flung a challenge to John Slater, a message bearer, while Slater was demonstrating his so-called "spirit power" before a gathering of over two thousand believers, who were assembled from the four corners of the world. Although the spiritualists succeeded in evicting Dunninger from the auditorium, Slater did not succeed in reading a message in a sealed envelope, for which Dunninger offered a reward of $21,000, and for which he held his check in evidence of his sincerity. The name of Ponzi, the meteoric wizard of high finance, remains vividly in the minds of newspaper readers. Ponzi was for a brief time a master of finance, through whose amazing ability the entire world stood in awe. Dunninger was appearing at Steinert Hall, in Boston, at the height of Ponzi's reign. One of the editors of a Boston paper influenced him to meet Ponzi, and it was through his mental investigation of Ponzi's mind that sufficient evidence was supplied to the authorities eventually to lead to the exposure of this money wizard's methods.

A most interesting experience during Dunninger's career was one in which he was called to assist in the solving of a prominent murder case, of a high police official, in Washington, D. C. He solved,



**Dunninger's appraisal of Trader Horn's mentality was exceptionally high**

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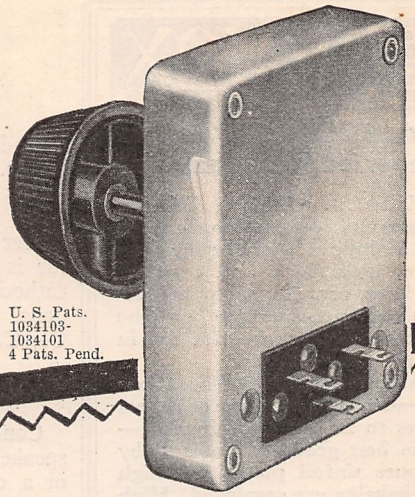

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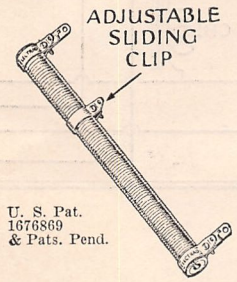


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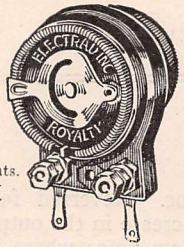


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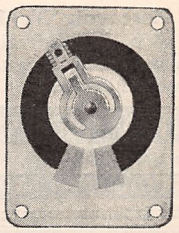

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## The Experimenter

(*Continued from page 350*)

cathode or the filament to the various points. This is a better connection than using B minus as the starting point. Thus in Fig. 1 "C" the by-pass condenser in the plate circuit of the detector is connected from the plate to the cathode and not to B minus as is often done. Referring to the connections of C1, C2 and C3, there is no alternative.

### *Connection of Speaker*

Concerning the connection of the loud speaker, there are three different choices in a circuit of the type shown in Fig. 1. It could be connected across the choke coil L, and this connection is often used. When this is used, the signal current must go through the eliminator. Common coupling results. It could also be connected from the plate to B minus. The signal current is then forced through the grid bias resistor. Reversed feedback results and a decrease in the output, particularly on the low notes where the by-pass condensers are ineffective.

The third method is illustrated in Fig. 1. The speaker returns to the filament. There is no reversed feedback and no signal current through the eliminator, except that which goes through the choke coil. This is small, so the method illustrated is by far the best.

But this connection is not applicable when the output device is a transformer or when the speaker is connected directly in the plate circuit. But in those cases, a large condenser may be connected from the filament to the B plus side of the speaker or the transformer.

### *Volume Control in A. C. Circuits*

One of the difficulties with a. c. circuits is to provide a suitable and adequate volume control. A variable resistor may be placed in the antenna. Usually this is not adequate, although it is very good as far as control of volume is concerned. A very good control is illustrated in Fig. 1. If the variable grid bias resistor R1 is made large enough and has a low minimum, it may be used to control the volume effectively. It not only changes the grid bias and so controls the volume, but it also varies the total resistance in the plate circuit. Hence, it serves both to vary the bias and to introduce a resistance in the plate circuit.

### *Operation of Screen Grid Tube*

Screen-grid amplifiers are often inserted in receivers in the hope that high amplification and stability will be achieved. Not infrequently the change in the circuit accomplishes neither. The reason is usually that necessary precautions have not been taken. To gain stability with high amplification every precaution must be taken to prevent feedback and to gain high amplification, the proper voltages must be applied. The load impedance must also be high.

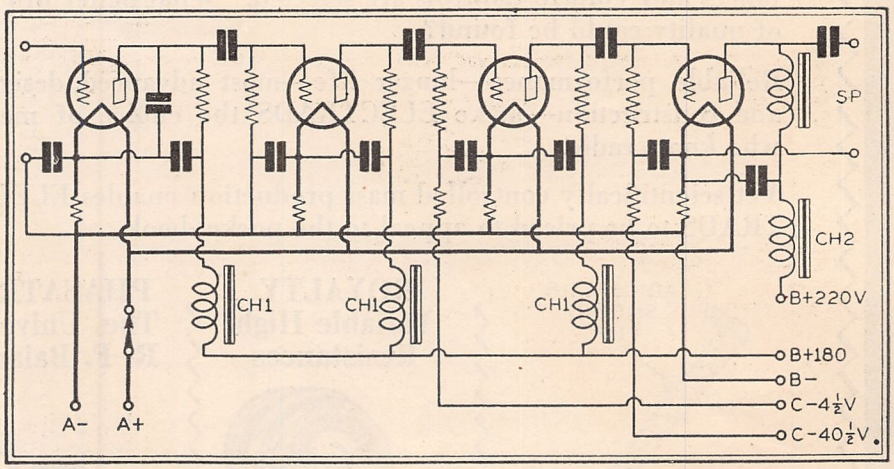


Fig. 3

The grid bias should be about 1.5 volts. If the entire filament ballast resistor is placed in the negative leg of the filament and the grid return is connected to A minus, the bias is too high. It is better to put 10 ohms in each leg as illustrated in Fig. 2. If a volume control is put in the filament circuit, it should be put in the positive leg. About 25 ohms is a suitable value.

Stability is achieved by filtering the leads and by shielding the entire stage, not only the tube alone. The connection of the filter condensers is shown in the diagram. Note that all of them are connected to the negative end of the filament. One condenser is across the grid bias resistor, another across the screen-grid and a third across the plate supply. A suitable value for each of these in a radio frequency circuit is .01 mfd.

A radio-frequency choke coil of 85 millihenries is put in series with each of the screen-grid and plate leads.

A necessary condition for high amplification is that the load impedance be high. That is, the primary winding on the coupling coil should be large and it should be closely coupled to the second-

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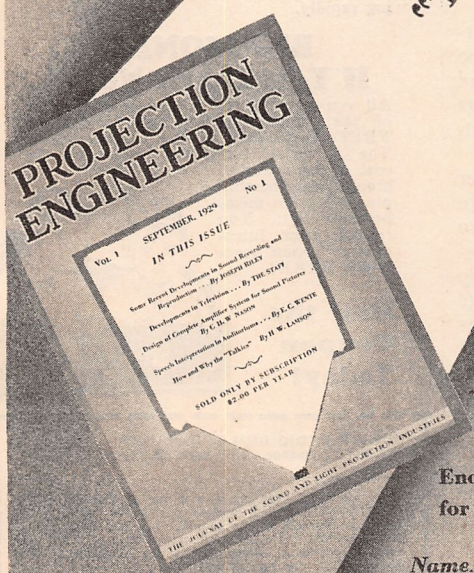
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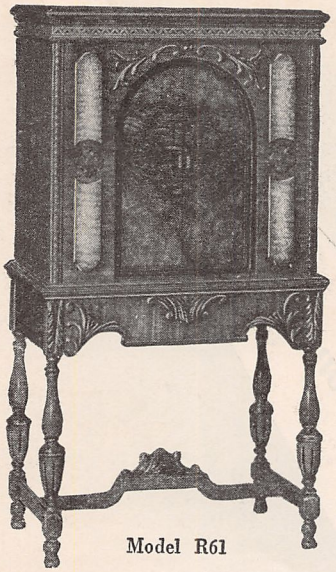

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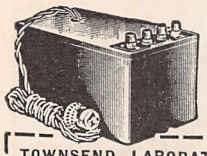

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### *Motorboating and Howling*

The greatest trouble in amplifiers is motorboating and howling. The disturbances may have any frequency from a slow waxing and waning of the signal similar to very slow fading to a superaudible frequency. Sometimes the noise is due to microphonic tubes but in most cases it is due to low frequency feed back. If due to microphonic tubes, the noise can be usually stopped by employing a different detector tube or by protecting the tube from the sound waves emitting from the speaker.

If the trouble is due to feed back, it is difficult to stop. The feed back takes place in most instances through the B battery eliminator or the batteries. When it does it is termed "motorboating" whether or not the frequency is audible.

Motorboating rarely takes place except in the very best amplifiers. But if the B battery eliminator is inadequately bypassed, it may take place in any amplifier having two or more stages.

The remedies for this condition are based on isolating the different stages so that there is no feed back, or on reducing the amplification of the circuit at the frequency of the disturbance.

If the noise is above the middle register, just plain by-passing of the plate leads is usually sufficient. If the disturbance is at a very low frequency, by-pass condensers do not help much. But if the circuit is direct coupled, a reduction of the stopping condenser or of the grid leak resistance is effective. In severe cases both may have to be reduced. Suitable filtering helps. Fig. 3 shows a resistance-coupled amplifier in which a thorough job of filtering has been done to eliminate as much as possible the cause of motorboating.

### *Placement of By-Pass Condensers*

All the by-pass condensers in this circuit are connected to the filament of the tube with which they are associated, and not to the B minus lead. Condensers are not only used in each plate circuit, but also in each grid circuit.

In addition to the condensers, a filter choke is used in series with each plate and a resistor in each of the last two grid leads. These resistors are used because the grid bias is taken from a drop in the B battery eliminator voltage divider. The first three series chokes may be replaced by resistors of about 10,000 ohms. The fourth choke, CH2, should in all cases be a choke of low resistance; it may be of the same type as the coupling choke in the same plate circuit.

The larger the by-pass condensers across the grid and plate leads, the better will be the filtering. It may seem a waste of condensers to some but they are the price of stability and the highest quality. The circuit which has been treated like the one in Fig. 3 will have a response characteristic like the theoretical, and no resistance or impedance-coupled amplifier served by a B battery eliminator will have it, unless the circuit is adequately and thoroughly filtered as illustrated.

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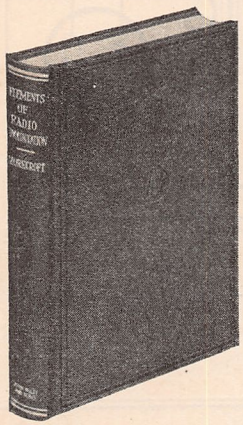


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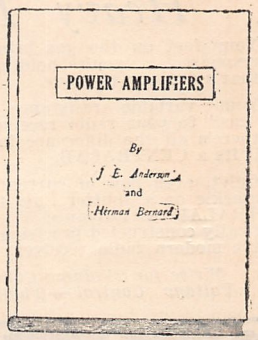
[NOTE: *The standard book on tubes for advanced students is "The Thermionic Vacuum Tube," by Hendrik Van der Bijl. Order Cat. VDB @*.....$5.00]

### ANDERSON and BERNARD
**"Power Amplifiers"**




Here is the *first* book to be published on the subject of "Power Amplifiers." Now printing, it is certain to fill a void in radio literature. The whole subject is fully covered in a masterful theoretical discussion of audio amplifiers and power supplies, supplemented by constructional chapters, with complete wiring diagrams and specification of parts. Learn while you build! J. E. Anderson, M. A., technical editor of RADIO WORLD, and Herman Bernard, LL. B., managing editor of RADIO WORLD, both of the Institute of Radio Engineers, have explained fully the phenomena of power amplifiers. Learn all about motorboating and its cures, push-pull theory and practice, grid bias methods and effects, vacuum tubes in audio circuits, AC and battery type AF amplifiers, phase relationships, common impedance, filter systems, by-pass condenser effects, necessities for tone quality, values of coupling constants, and a host of other topics associated with power amplification, including speech amplifiers and "talkie" installations.

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Two new books by John F. Rider, R. E., Member, Institute of Radio Engineers, constitute the series grouped by him under the heading "Service Man's Manual." Part I is "Mathematics of Radio." Part II is "Trouble Shooter's Manual."

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"The Mathematics of Radio," 128 pages, 8½x11", 119 illustrations, bridges the gap between the novice and the college professor. It gives a theoretical background so necessary for a proper understanding of radio and audio circuits and their servicing. Flexible cover. Order Cat. MOR @....$2.00

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*This book is worth hundreds of dollars to any one who shoots trouble in receivers—whether they be factory-made, custom-built or home-made receivers. The home experimenter, the radio engineer, the custom set-builder, the teacher, the student—all will find this new book immensely informative and absolutely authoritative.*

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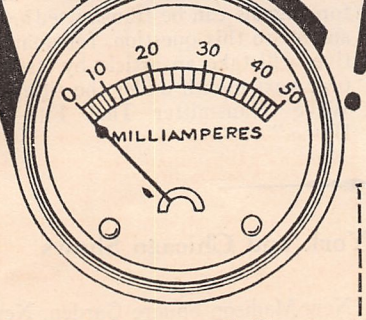


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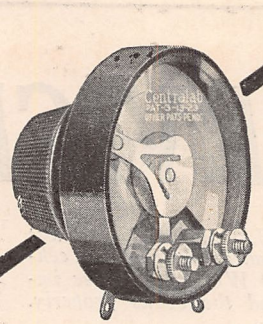

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## Breaking Into Amateur Transmitting

(*Continued from page 322*)

graph, the key should be grasped lightly between the thumb, forefinger and middle finger; the other fingers take care of themselves. The round forearm muscle rests easily on the table; the whole arm is relaxed; motion is chiefly confined to the wrist and upper forearm. Another rule of sending, which could be adopted with benefit by many old timers, is: send slowly with regular spacing. Slow, even sending will get through a message much faster than a machine gun delivery which cannot be copied.

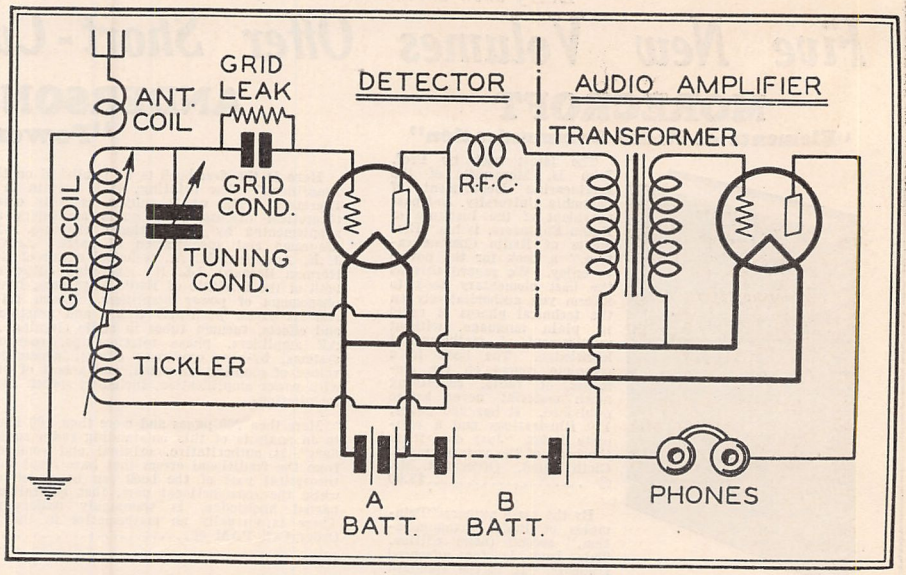



**Fig. 4. Another requirement of the Government test is to draw the complete circuit details of your short-wave receiver**

### *Licenses*

As all radio activities are controlled locally by the Supervisor of Radio, applications for the required operators and station licenses must be made to him. The supervisors are stationed at Boston (1st district), New York (2nd), Baltimore (3rd), Atlanta (4th), New Orleans (5th), San Francisco (6th), Seattle (7th), Detroit (8th), and Chicago (9th). The district boundaries on the map (Figure 2) show at a glance which district you are in. You must make formal application in writing for each license, and for the operator's license pass a code test at ten words per minute and a short theoretical examination as well. This examination usually includes diagramming and explaining the operation of your transmitter and receiver (see Figs. 3 and 4). Other electrical queries are usually combined with a few questions about radio law—for instance: No operator may divulge the contents of private messages he may copy; no one shall send out a false distress signal; amateurs must stay within their allotted bands and observe evening and Sunday morning silent hours when their transmission would interfere with other services. The two types of licenses are illustrated in the photographs. Though the operator's license happens to be a 1st Class Commercial one, for which a 20 word code test and a theoretical examination lasting several hours are required, the general form and wording of an amateur license is the same.

When a first class receiver has been installed and when the operator is well on his (or her) way toward getting the necessary licenses, it will be time to think of building the transmitter. Here there may be a serious obstacle, usually human, in the form of a father, a wife, or perhaps some more distant yet equally insistent relative. The question arises: is it necessary to submerge everything else around the house in a maze of wiring before signals can be transmitted? The full answer to this question, fortunately negative, will take an article by itself, to appear next month under the title "A Short Wave Transmitter That Fits into the Home."

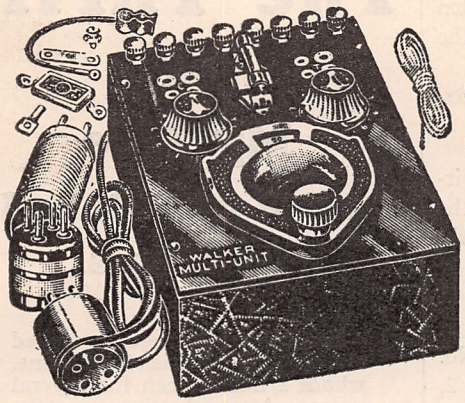
## Radio News at the New York and Chicago Shows

To those of our readers who will attend either the New York or the Chicago radio shows, a cordial invitation is extended to make our booth their headquarters:

SIXTH ANNUAL RADIO WORLD'S FAIR, New Madison Square Garden, New York, September 23 to 28 inclusive, RADIO NEWS will occupy booth No. 2, Section II.

EIGHTH ANNUAL CHICAGO RADIO SHOW, Coliseum, Chicago, RADIO NEWS will occupy Booth No. 27, Section H H.

# A Radio Utility and Entertainer




## George W. Walker "MULTI-UNIT"

*A Device with a Dozen Uses*

SHORT WAVE RECEIVER — SHORT WAVE ADAPTER
REGULAR BROADCAST RECEIVER
SCREEN GRID PRE-AMPLIFIER — R. F. OSCILLATOR
EXTRA STAGE OF R. F. OR "BOOSTER"
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One of the most unusual radio instruments ever devised. Will perform any individual function of a complete receiver, and in addition may be used for calibrating, testing or checking. Makes a wonderful broadcast receiver, short wave receiver or transmitter. Oscillates violently over the entire scale range from 550 meters down to 15. Uses all tubes 199 to 210 and all voltages, A.C., D.C., or rectified. Nothing like it ever placed on the market before.

**The Radio Fan** has at his disposal a device which will provide him with something to tinker with for an entire season without performing the same experiment twice. Become acquainted with all the circuits and the way tubes perform under particular conditions.

**The Dealer and the service man** require this most valuable instrument for adjusting radio frequency circuits to resonance, providing a beat note or constant frequency oscillation for determining wave length of a particular condenser setting, calibrating a receiver disposing of trade-ins and obsolete sets by making them up to date by the addition of an R. F. amplifier.

### NO ANTENNA-GROUND NEEDED

When using the Multi-Unit with most any receiver as an R. F. Booster (extra stage T. R. F.), the sensitivity increase is sufficient to make unnecessary the use of outside antenna. Tone quality is immediately improved. Less external electrical interference assured.

### SHORT WAVE CONVERTER
**(15-95 Meters)**

Enjoy the novelty of short wave experiments by converting your present receiver to tune to the low waves. Utilizing the audio amplifier in your own receiver serves a dual purpose and increases volume and range. Plug the unit adapter into the detector socket of your set. No change in wiring or extra tube required. The Multi-Unit will function with either A. C. or D. C. receivers.

### R. F. PRE-AMPLIFIER

Uses same type tube as in the R. F. stages of your present receiver. 199, 201-A, 222, 224, 226 or 227 tubes may be used. Either A. C. or D. C. Extreme selectivity, if you prefer. Tune in stations you never heard before. This efficient circuit reduces static and other interference. Greater clarity results as the additional volume makes over-loading of tube filaments unnecessary.

### SCREEN GRID R. F. BOOSTER

Increase the range and volume of your present receiver to equal the latest improved Screen Grid Receiver. Merely insert unit adapter plug in socket of your receiver. No change in receiver wiring. Adaptable to either A. C. or D. C. receivers.

### SHORT WAVE RECEIVER
**(15-95 Meters)**

Experiment with the fascinating short waves. Tune to stations thousands of miles distant. Reception of short wave Foreign stations has been verified. Ideal all-year-around reception. Warm weather in Australia and New Zealand is winter in this country. Hundreds of short wave stations thruout the world are listed.

### SINGLE TUBE RECEIVER

Ideal for either short wave or regular broadcast band.

### SHORT WAVE R. F. BOOSTER

Connect the unit ahead of your short wave set and hear stations with greater volume. Uses screen grid or 201-A type tube.

### R. F. OSCILLATOR

Check your receiver for wavelength and calibration. Determine resonance of circuits, test tubes for oscillation and regeneration, neutralizing receivers, balancing condensers, laboratory measurements, short distance transmission and generating a beat frequency for superheterodyne.

There are numerous additional uses, a few of which are wave meter, Loop R. F. Amplifier and growler for measuring efficiency of shielding material. By the time an experimenter has exhausted the possibilities of this instrument he will be qualified for a radio engineer.

Consists of the essential parts of an oscillatory circuit, and in addition are plug-in coils, adapter cord and plug, bridging connections, and extra wires along with well detailed instructions for many major experiments. Entire unit contained in box 7½ inches by 5 inches by 3½ inches. Price ..... **$16.00**

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This year, for the first time, both shows will include a Parts and Raw Materials Directory. With the official approval of the Radio Manufacturers Association it will be used as a buying guide by the industry's chief engineers, sales executives and purchasing agents. Every manufacturer who supplies material to the radio manufacturing industry should be represented.

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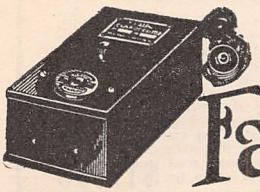

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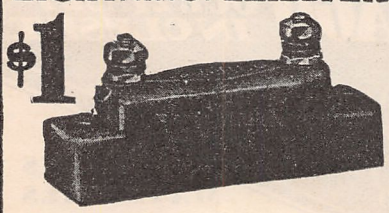


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CORNISH WIRE COMPANY
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MAKERS OF
CORWICO BRAIDITE HOOK UP WIRE


(*Continued from page 356*)

tector tube socket and grid leak mount.

When you are satisfied that you have placed these parts in the correct position they may then be fastened down to the baseboard with woodscrews.

So much for the assembly of the parts.

### *Wiring the Audio Amplifier*

To simplify the description of the wiring procedure, the transformer at the extreme right end of the baseboard will be referred to as Transformer No. 1; the socket to its left as Socket No. 1; the Amperite to its left, Amperite No. 1; the next transformer, Transformer No. 2; the socket to its left, Socket No. 2, and finally the Amperite to its left, Amperite No. 2.

The first step in the wiring job is to wire both grid circuits, then both plate circuits, then both filament circuits, and finally the B and C battery circuits.

First, connect a wire with the terminal marked "Grid" on Transformer No. 1 to the "G" terminal on Socket No. 1. Next connect a wire from the terminal marked "Grid" on Transformer No. 2 to the "G" terminal on Socket No. 2. Then connect a wire from the terminal marked "P" on Socket No. 1 to the terminal marked "Plate" on Transformer No. 2. Connect a wire from the terminal marked "P" on Socket No. 2 to the upper terminal of the Loud Speaker Jack mounted on the panel. Now unsolder the lead attached to the phone tip Fahnestock clip marked "P" and resolder it to the terminal marked "Plate" on Transformer No. 1. The wire connected to the other Fahnestock clip, marked "B plus," is next unsoldered, the clip removed, and the wire resoldered to the terminal marked "Pos. B" on Transformer No. 1. This latter wire is the one which leads to the Yellow terminal on the Cable Receptacle.

Now connect a wire from the "F plus" terminal of Socket No. 1 to the end of the Amperite No. 1 nearest the panel. Connect a wire from the "F plus" terminal on Socket No. 2 to the end of Amperite No. 2 nearest the panel. Next connect the free ends of both Amperites together and continue the connection to the Red terminal on the Connector Cable Receptacle. Then connect both "F minus" terminals of the sockets together and continue the connection to that side of the Filament Switch, mounted on the panel, to which is connected the wire leading to the "F minus" terminal on the detector socket. This particular switch terminal can be easily identified because it is the one that *does not* lead to the Black terminal on the Connector Cable Receptacle.

To complete the B battery circuits it is necessary to connect a wire from the terminal marked "Pos. B" on Transformer No. 2 to the Blue terminal on the Connector Cable Receptacle. Then connect a wire from the other vacant terminal on the Loud Speaker Jack to the Gray terminal of the Receptacle.


# The Thrill of My Life
## And How I Gave It to Others

Several weeks ago I visited an old school friend of mine, whom I hadn't seen for several years. After chatting a while, she asked me if I had ever been to a spiritualistic meeting. I said, "No, but I'd like to go."

So she took me over to a friend of hers whom she said was a medium that could actually show me spirits, talk with them, and receive messages from them about the dead.

Of course, I didn't believe it, but I sat down in a darkened room with several others.

All of a sudden tables began to jump, lights flashed, grave voices spoke and ghosts appeared before my very eyes. For an hour this went on, my hair standing on end half the time, and the other half I tried to control myself to keep from running.

When it was all over I wiped the perspiration from my brow, fully convinced that spiritualism was the real thing, and walked out into the open air thrilled to the very marrow of my bones.

As we started for home, my friend began to chuckle. Very indignantly I asked her what she thought was funny, for my knees still trembled. But she said not a word until we arrived home, then pulling down a big book from her book-shelf she handed me "Houdini's Spirit Exposes," and as I glanced through the beautifully illustrated pages I realized that I was a victim of a huge joke. For everything the "medium" did was clearly explained within this one volume, with dozens of other stunts that one could easily do. Houdini, the world-famous magician, has merely set down all the tricks of his trade in one huge volume, and these tricks were reproduced to give me my thrill.

You, too, can be the life of the party, and the center of a great evening's fun, by getting "Houdini's Spirit Exposes." You, too, can give your friends the thrill of their lives.

Send today! for the complete volume, in the large 9 by 12-inch size, with over 112 pages of fascinating, illustrated tricks of magic. And the price complete is only 50c postpaid! Money back if not perfectly satisfied!

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I want to give my friends the thrill of their lives and enclose 50c, for which please send me postpaid your big book, "Houdini's Spirit Exposes."

Name.....

Street.....

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Now, the terminal on Transformer No. 1 marked "Neg. Fil." connects to the green terminal on the receptacle, while the similarly marked terminal on Transformer No. 2 connects to the brown terminal on the receptacle.

The grid and plate connections need take up only a small space between the units; in fact, the less space the better. The filament, B battery and C battery circuits, the latter connecting to the "Neg. Fil" terminals on the transformers may all be arranged neatly in cable formation along the rear edge of the baseboard. To keep these wires in place they may be bound with cord, but care should be exercised in this stage of the work to see that the cord does not cut the insulation covering the wire so as to cause possible short circuits.

### *Operation*

After the wiring is completed the receiver is ready to operate as a three tube set. The signals will be loud enough to operate a loud speaker, and, when the proper values of B and C battery are used, as specified in Fig. 9, appearing in Lesson Number Two. (Radio News for September, 1929, Page 247), together with the correct vacuum tubes, a very fine tone quality of sound reproduction will result. In the first audio stage (Socket No. 1) a type 201A tube should be used. In the output stage (Socket No 2) a type 112A tube should be used.

To operate the receiver, assuming that all the batteries are connected to their proper wires, insert the amperites in their mounts, then insert the tubes in their respective sockets.

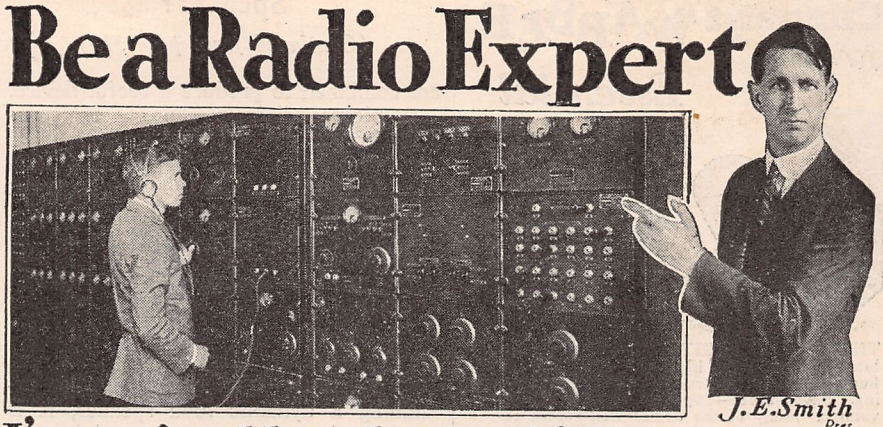
When the filament switch is turned on and a station tuned in, the music or speech will be many times louder than that heard in the phones with only the detector unit working. Since there are no variable features about the two-stage audio amplifier unit, no adjustment of it is required to keep it in satisfactory operation. Simply tune and operate the set as you did when you had only the detector unit.

## Erratum Notice

In our September issue we published an article (p. 231), "Dr. Lee DeForest Writes the Reminiscences of a Radio Pioneer." There were several interesting illustrations, in that article, of some of Dr. DeForest's early experiments.

In view of the fact that the editor of *Radio Broadcast,* Mr. Willis K. Wing, was kind enough to lend those illustrations to us, we should have made the usual acknowledgment. Since this was omitted through an oversight, we take this opportunity of calling attention to the omission, acknowledging our obligation to *Radio Broadcast,* and sincerely apologizing to Mr. Wing.—THE EDITORS OF RADIO NEWS.


# Be a Radio Expert



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## What Is a Good Loud Speaker?

*(Continued from page 319)*

are combined to produce a useful device.

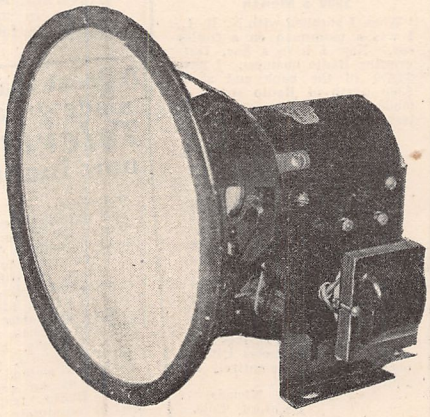
A picture diagram showing the construction of an ordinary dynamic loud speaker is given in Fig. 3. The loud speaker consists of the following essential parts:

(a) the cone.
(b) the moving coil.
(c) the centering strips.
(d) the coupling transformer.
(e) the magnetic core.
(f) the field coils.

If one knows what to expect when examining a dynamic loud speaker, it is much easier to form some opinion regarding it. Let us examine in some detail the design, purpose and construction of the various sections listed above.

### *The Cone*

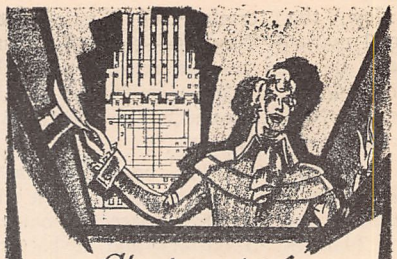
The cone is usually made of a stiff paper formed into a conical shape so that maximum rigidity with a minimum of weight is obtained. The paper must be such that it does not alter in shape or size due to temperature variations and it must not be affected by dampness. The paper must not be subject to fatigue—these characteristics in the paper are essential if the loud speaker is to give long, useful service.



**To energize the field coil of the dynamic, various power supplies are employed**

Until quite recently paper was the only material used in the construction of cones of any type. At present, however, the writer knows of one special material designed specially for use as a diaphragm material in dynamic loud speakers. It is known as Burtex and is used in a number of dynamic loud speakers. Its makers claim that it is unaffected by the weather and that a more efficient loud speaker with a somewhat better frequency response can be constructed by the use of Burtex. It's possible that there are some other special diaphragm materials on the market with which the writer is not familiar and which also have advantages over paper.

The angle at which the cone is formed is quite important. It determines the stiffness of the diaphragm and it also alters to some degree the frequency re-



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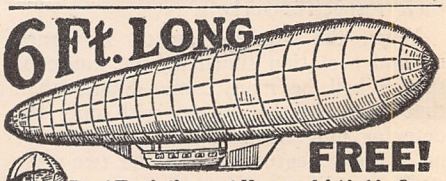

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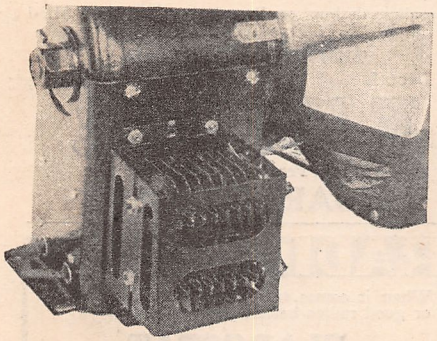
sponse characteristic of the loud speaker. The cone, small though it is, acts, at high frequencies, like a small horn. The larger the angle the smaller is the horn effect, but with large angles the cone is less rigid, which affects the efficiency and the low frequency response.

The cone is supported at the outer circumference by a strip of some soft, pliant material such as thin leather. It is essential that this supporting material be light and flexible so that it will not hinder the movements of the cone.

### *The Moving Coil*

The position of the moving coil is clearly indicated in Fig. 3. The coil is generally wound on a support made of some thin insulating material which, in turn, is cemented fast to the paper cone. In the case of a diaphragm made of Burtex the support for the coil is part of the cone itself.



**The dynamic shown here employs a stepped-down 110-volt line source rectified by the dry rectifier illustrated**

The number of turns used for the moving coil may be anything from one up to several thousand. Generally, however, the coils consist of about one or two hundred turns of fine wire, about No. 35 gauge.

The coil and its support must move axilly to and fro in the air gap during operation of the loud speaker and it is therefore essential that the coil and its support be accurately centered in the air gap and that means be provided to maintain it in this position. In some models a thin spider web form is used for this purpose. Other dynamics make use of three light thin springs which serve to hold the moving coil accurately in the center of the gap and permit no movement sideways although permitting very free movement in the direction of the axis of the cone. The major requirement of the centering device is that it be stiff enough to accurately keep the coil centered but that it not interfere with the normal movements of the cone.

Some dynamics using light springs to center the coil also use these springs to convey the current to the moving coil. In other models current is supplied to the coil via two fine wires cemented along the cone.

### *The Coupling Transformer*

The moving coil system of a dynamic loud speaker has, generally, quite a small electrical impedance. At low frequencies

(*Continued on page* 370)

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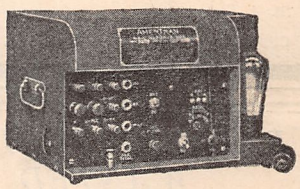

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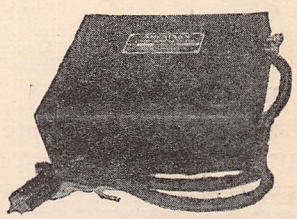

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(*Continued from page 369*)

the impedance of the average dynamic is something in the neighborhood of 10 to 25 ohms. If the loud speaker were ideal this impedance would be constant and of pure resistance at all frequencies. Actually the impedance of a moving coil speaker varies with the audio frequency, gradually increasing in value with increases in frequency.

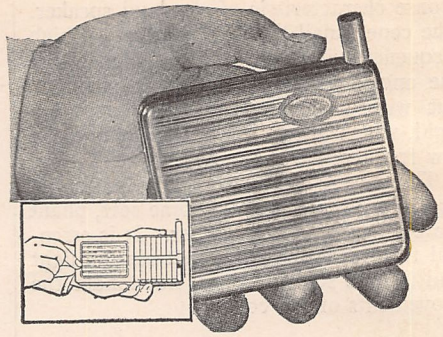
At all audio frequencies the impedance of the average moving coil system is, however, much lower in value than the plate impedance of a power tube, and for this reason a coupling transformer must be used to adapt the impedance of the moving coil system to the plate impedance of the power tube. If we were to try and operate a dynamic loud speaker without any coupling transformer between the tube and the moving coil, we would find that the volume would be very low and that considerable distortion would be produced.

Coupling transformers as used in the ordinary dynamic loud speaker are generally designed to operate satisfactorily with any ordinary type of tube. In such cases somewhat increased efficiency would be obtained through the use of a special coupling transformer designed to operate satisfactorily with any ordinary type of tube. In such cases somewhat increased efficiency would be obtained through the use of a special coupling transformer designed to work with the particular tube to be used. At least one manufacturer, the Silver-Marshall Company, get around this problem very nicely by using a transformer with several taps on the primary so that the proper ratio for most efficient operation can be obtained no matter what power tubes or arrangement of power tubes the loud speaker might be supplied from.

### *The Iron Core and the Field Coils*

The operation of a dynamic loud speaker depends upon the reaction of two magnetic fields, one due to the audio currents flowing through the moving coil and the other due to the currents flowing through the field coils. The currents flowing through the field winding set up a steady magnetic flux throughout the field circuit. The part of this flux which is useful is that part which passes across the air gap where the moving coil is located. It is at this point that the field flux reacts with the currents in the moving coil to cause the coil to move. The larger the audio currents through the moving coil and the greater the value of the steady flux due to the field, the greater the movement of the cone and therefore the greater the sound produced. It is of advantage therefore to get in the air gap as high a flux density as possible. Commercially, the loud speaker manufacturer designs the units for maximum flux density consistent with reasonable cost and a reasonable amount of power consumption from the source supplying the field power.

Power to supply the field may be obtained from a storage battery, from the filter system in a B power unit, or from the light socket. In the case where the

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light socket supplies a. c. the loud speaker is equipped with a rectifier so that d. c. is available for the field circuit.

This completes the technical discussion of the dynamic loud speaker. If it has accomplished what we hoped it would, the reader will have obtained from the preceding discussion a good idea of the relation of the various parts used in a dynamic loud speaker.

It is only when one has some idea of the general design, construction and purpose of the various parts of any device that one can properly compare one loud speaker with another. A man who goes into a radio store and says "I want a set" and then after listening to a half dozen decides to buy some particular one is very much like the traveler who goes on one of those "personally conducted" tours. He sees and hears what is shown to him—he never knows what he may be missing! The traveler—and the radio experimenter—who gets to know all the by paths is the one who gets off the beaten path and sets out for himself. He may bump his shins but in the end he has a good time and the satisfaction of having found out things for himself.


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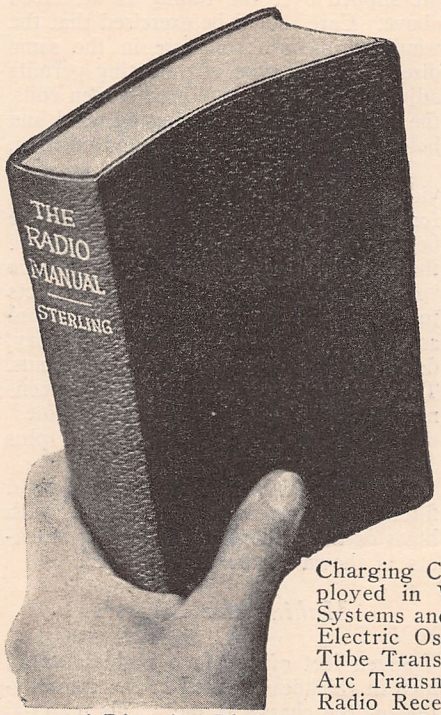


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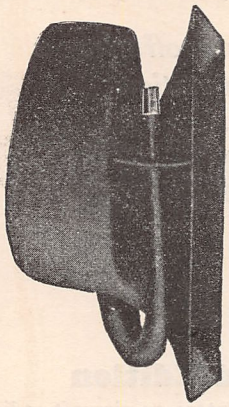

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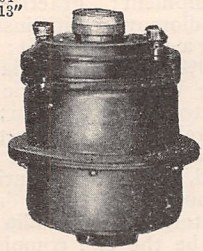

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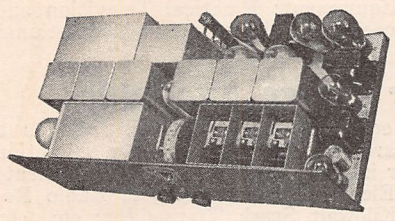

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# Building the Seven-Tube Magister Tuner

(*Continued from page 308*)

time they are clamped or pressed between two boards to remove the excess cement and to make them of uniform thickness. This thickness will be the same as the width of the bakelite rings.

After the slot wound coils are hard and dry, they are assembled on one inch diameter tubing three inch long. The tubing is split and a 1/8 inch section removed along its length. The coils may be easily slipped over the tubing by springing the one inch diameter tubing together. Two coils with their respective bakelite cores are slipped over the tubing as described above. Care should be exercised that the windings of both coils are in the same direction. This type of mounting permits adjustment of the coupling between coils, the slotted tubing springing outward and holding the coils in the adjusted position.

These band filter transformers are provided with lug terminals as also provided for the other coils described above. The bottom coil is used for the primary while the top coil is used as the secondary. The "outside" of the secondary coil connects to the grids of the tubes and is designated as "O." The "inside" of the secondary, designated "I," is connected to "B" minus. The "inside" of the primary "I" is connected to the plate while the "outside," designated "O," is connected to "B" plus 180 volts.

The antenna, oscillator, r. f., and band filter transformers are provided with brass or thick aluminum mounting brackets as shown in the detail sketch.

## *Making the Chassis*

Seven feet of one inch angle brass 1/8 inch in thickness is used in the construction of the chassis frame. This material is cut to lengths of 29 inches and 10 inches respectively. Two of each are required. The ends of the angle brass are cut to a 45 degree angle on the surfaces to be used as the top of the frame. The iron corner pieces as mentioned in the list of parts (these are obtainable from any hardware store) are placed in proper position. The positions of the holes to be drilled and tapped for 8-32 screws are marked, after which the angle pieces are drilled and tapped. The ends of the angle pieces are butted together tightly and the resultant rectangular frame should have perfectly square corners as otherwise the chassis will be lop-sided. This construction is shown in detail in the drawings of Fig. 5. To further strengthen the frame the iron corner brace pieces are soldered to the brass angle pieces. An additional piece of flat metal is soldered to the under surface of the brass angle directly over the joint for better re-enforcement. This work results in a very strong frame and support which is greatly desirable for a receiver of these dimensions.

## *Assembly of Shield Compartments and Partitions*

After the chassis frame has been made, a single sheet of aluminum 3-64 or 1-16 inch thick is cut to fit the top of the chassis frame. This serves as the bottom of the shield compartments as well as the common electrical connection when wiring the receiver.

The positions of the various slotted corner and partition posts holes are spotted, as shown in Fig. 5, on the bottom plate and drilled. The bottom plate is then placed in position on the chassis frame, the position of the holes marked on the frame which is in turn drilled. Care should be taken in spotting the position of the corner and partition posts, that they are square with the frame, as otherwise the shield compartments will be out of line.

The frame, bottom plate, corner and partition posts are now assembled together. This is accomplished by passing 6-32 machine screws through the holes of the chassis frame from the under side, through the holes in the bottom plate and screwed into the tapped holes at the ends of the posts. This makes a very neat and professional appearing assembly job.

The ten inch partitions are now slipped into place as shown in the picture diagram. Also the partition separating the i. f. compartments from the oscillator compartment. The inter-compartment partitions are now measured as to exact width, allowing 3/8 inch on each side for the turned over edges. It is wise to spot the positions of the fastening holes in these turned over edges and drill them before bending. After the inter-compartment partitions have been drilled, the turn overs are bent, trying not to warp the material any more than necessary in the bending process. These partitions are then placed in their respective positions, and the position of the holes in the turned over edges marked on the ten inch partitions, and drilled. This applies as well to the partition separating the first i. f. compartment from the drum dials and the partition separating the second i. f. from the power detector compartment. The three aluminum pieces for shielding of the band filter transformers from the chokes and screen-grid tube are now cut to size allowing 3/8 inch on each side for the turn over edges. These pieces are then bent into shape. When fastened into place these will make shield compartments 3 inches square.

Four of the ten inch partitions are also drilled for 1/2 inch holes to allow the passage of the condenser shafts thru each compartment to the drums.

## *Mounting Variable Condensers And Drums*

The positions of the variable condensers are now marked on the bottom plate. To expedite matters it would be convenient to scribe the exact dimensions of each compartment on the bottom plate.

The type F drum dials are now placed in position. The projection on the bottom of the drum support frame is re-

## On Short Waves

(*Continued from page 352*)

in phase with each other, the tickler coil is in the feedback position and will add to the resultant signal strength. The feedback from the plate circuit to the grid circuit is at radio frequencies, therefore, a by-pass condenser is connected from the lower side of the tickler to the filaments.

In Fig. 4 is shown another method for controlling regeneration. For short wave receivers, the action resulting from the use of this method is somewhat smoother than that shown in Fig. 3. The variable resister has a maximum resistance of 500,000 ohms and may either be connected in series, as indicated, or in shunt at the points marked X, X. When employing the variable resistance method for regeneration control, the secondary

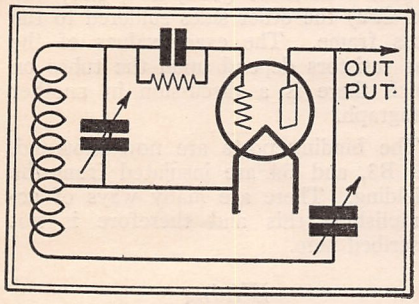


Fig. 6

and tickler coils are wound on the same form, a space usually separating the windings from each other about ¼". Many variable factors enter into a calculation for the number of turns for a tickler. A general rule may be used, of a secondary and tickler turn ratio of 1 to 1 for the lowest wavelengths, increasing the secondary turns to 2½ to 1 at 100 meters.

The method for controlling regeneration employed by a number of short-wave code receivers is shown in Figs. 5 and 6. Here a variable condenser is used as the regeneration control medium. In Fig. 5 a variable tickler is employed and after once being set need not be readjusted till such a time as some major change is made in the detector stage of the receiver. All feedback tuning is accomplished on the variable condenser. One precaution is necessary, being the connection of the rotor plates of the variable condenser to the tube filament circuit. In Fig. 6 the tickler is stationary, being wound on the same form as the secondary. The control condenser affords all necessary control of the feedback. Very little, if any, trouble will be experienced in either the variable resistor or the variable condenser regeneration in the logging of the grid turning circuit, as neither of these methods has the disadvantageous effect of that of the rotating tickler. Various other methods of providing regeneration may be used, such as, the link circuit, variable split winding and plate variometer. These forms of controlling regeneration are not practical for short-wave receivers, so they will not be discussed here.

Experiment with the various systems outlined here will tend to illustrate each one's own peculiarities, advantages or disadvantages.

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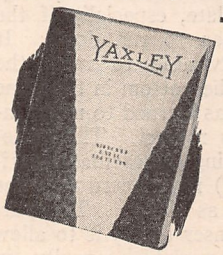


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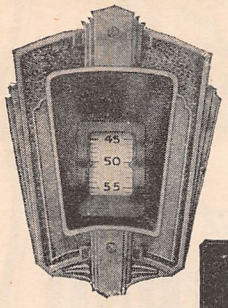

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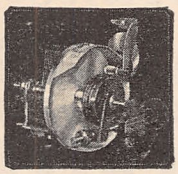

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moved with a hacksaw. The drums are separated by a distance of approximately ½ inch, and each is mounted approximately 1¾ inches on center on each side of the center line of the chassis. This line is approximately 14½ inches from either end of the chassis. The positions of the holes in the drum support frame are marked and drilled thru the bottom plate and chassis frame. The drums are fastened to the chassis by screws placed through from beneath the chassis frame and bottom plate, and are then screwed into the tapped holes of the drum support frame.

The condensers are next mounted. A line is scribed along the length of the bottom plate to the same distance from the front edge of the chassis as that measured from the edge of the chassis to the center of the drum shaft sleeve. The positions of the holes in the cast aluminum frames of the condensers are marked on the above line. The condensers should be centered in the r. f. compartments, and the oscillator condenser should be placed approximately one inch from the partition separating the condenser from the drum dial compartment. Brass pillars of such height to center the condenser shafts with the drum shaft sleeve, are placed under the condenser frames. The condensers are now fastened solidly in place. After which the condenser shafts are placed through the condensers and drum dials.

### *Mounting the Coils*

The various coils are now mounted in their proper positions in their various compartments. This work should be done before the shielding is assembled as it is more convenient to mount and wire the parts into the circuit as the shielding is assembled. This is especially true in respect to L3, L5, L6 and L7. The mica variable condensers for tuning the primaries and secondaries of the band filter circuits should also be mounted before mounting the band filter transformers.

The r. f. chokes are all mounted in the upright positions shown. Various positions or locations for these were tried before the positions as shown were found satisfactory.

### *Mounting of Additional Parts*

The sockets are now mounted in position. In mounting these it is advisable to raise them from the bottom plate by washers ⅛ inch thick. This work will eliminate possible shorting of the prongs with the bottom plate, especially if the solder should happen to run down. It would also be advisable to raise the variodensers from the bottom in the same way. The author has learned to never invite trouble in this respect. The variodenser (C29) shunting the oscillator variable condenser (C4) is mounted near the variable condenser as shown. The purpose of the variodenser (C29) is to allow adjustment of the variable capacity, in relation to the inductance of the oscillator coil, to a scale reading nearly the same as the r. f. scale. Its use is not entirely necessary. Should the builder desire to eliminate it, the grid or secondary winding of the oscillator coupler should be increased from 55 to 60 turns. The 1 mfd. by-pass condenser (C28) is now mounted in the oscillator compartment in the position shown.

The power detector bias resistor is mounted in the detector compartment. The midget detector plate by-pass condenser (C26) is also mounted at this time.

The two volume controls (R7 and R8) are fastened to the front sections of the shield compartments as shown. The latter resistor must be insulated from the metal. The by-pass condensers with the exception of (C26) and (C28) are mounted underneath the bottom plate. The grid suppressors used as bias resistors (R1, R2, R3, R4, and R5) are soldered to one lug of their respective by-pass condensers (C11, C14, C17, C19 and C22) the other sides soldered to the brass frame. The exact values of the bias resistors depend upon the tubes on which there is a discussion in another paragraph.

The binding posts are now mounted, B1, B3, and B4 are insulated from the shielding. There are many ways of accomplishing this and therefore is not described here.

### *Wiring*

In wiring the receiver it is advised that all high potential leads be wired first. This applies particularly to the grid and plate leads. These leads must be as direct and as short as possible. To further prevent feedbacks it is necessary to shield the grid circuit of each tube from its plate circuit as recommended by tube manufacturers. This is accomplished by using hollow metal braid, any of the various varieties on the radio market will prove satisfactory. The wire braid should of course be non-magnetic.

Beginning with the modulator, each compartment is wired completely, after which the partitions are fastened in place for that particular compartment. This procedure is carried out for each of the r. f. compartments. Beginning with the modulator compartment again, the i. f. transformers and their tuning condensers are wired, placing the shielding partition in permenent position after each is completed.

The balance of the wiring, composing the plate, screen grid "B" supply returns from their respective chokes, the negative and by-pass condenser returns are made in the order given. The a. c. supply for the tube heaters and the power switch are wire in last.

### *Preparing the Aluminum Cover*

The cover for the aluminum compartments is made from a single sheet of aluminum 27¾ inches by 10 inches by 3-64 or 1-16 inch thick. The holes for fastening the cover to the corner and partition posts are spotted on the cover and drilled. The position of the tube port holes is marked and cut out with either a circular cutter or by scribing a circle in the proper position and drilling

out with a succession of small holes drilled around the circumference, after which the small jagged edges are filed down with a round or half round file. The diameter of the port holes will be determined by the size of the port or caps. The author visited the 5 and 10 store and purchased seven of the large size aluminum shakers, the sort used by the kitchen help. These shakers had a diameter of 2¼ inches and were about the same height. A beaded rim or shoulder is found around the circumference about ⅝ inch from the bottom of the shaker. This raised shoulder served to prevent the cover from sliding through the port holes of the cover. The top portion of the shaker was removed to within ⅜ inch of the shoulder. It was also necessary to remove the end of the aluminum handle from the part of the shaker used as the cap. This was done by filing down the head of the aluminum rivet until the handle was loosened.

### *Tubes Used in the Receiver*

Using the new speed 224 type tubes the bias resistors (R1, R2, R3, R4 and R5) must have a value of 750 ohms. This value of resistance is an odd size with most manufacturers but the value was easily obtainable by placing two 1400 ohm wire wound resistors of the grid suppressor type in parallel. If the old type 224 is used the value of the bias resistor must be 375 ohms for normal rated operation.

The Speed 227 type tube, of the quick action heater type, was found to be a very efficient oscillator when used in the "Magister" circuit.

### *Adjustment of the Receiver*

When the wiring of the receiver has been completed, do not be afraid to test the receiver for shorts or other possible incorrect connections. When the builder has assured himself that the receiver is properly wired, the various power supply leads of the receiver are connected to the indicated voltages on the power supply unit. The antenna and ground are connected. A 250,000 ohm. resistance and one side of a 1 mfd., by-pass condenser are connected to the detector plate binding post. One terminal of a pair of phones is connected to the remaining side of the condenser. The remaining terminal of the phones may be connected to either the detector cathode binding post or to the remaining open end of the resistor. This end of the resistor is also temporarily supplied with from 135 to 180 volts from the power unit.

Provided the inductance of the r. f. secondaries are nearly the same, as well as the variable condensers (matched condensers in sets of three may be obtained from the manufacturer), no compensation of these stages will be necessary other than to set the condensers at their maximum capacities and tightening the rotors to the shafts by the set screws provided for that purpose. At this time the oscillator condenser shaft may be fastened and then both drums adjusted and tightened at their maximum scale indication.


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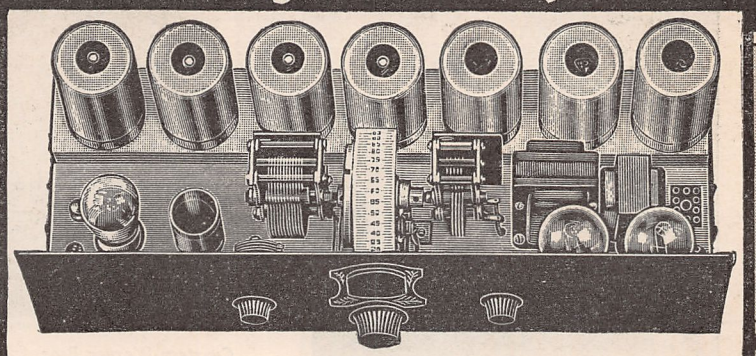

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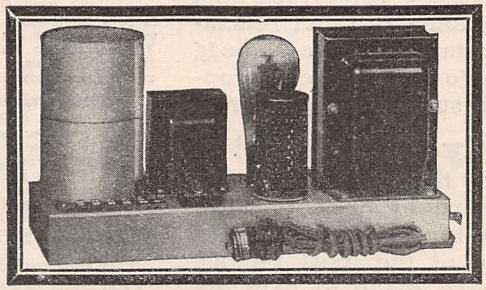

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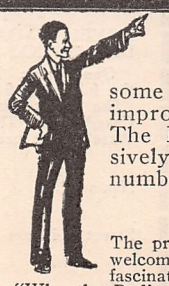

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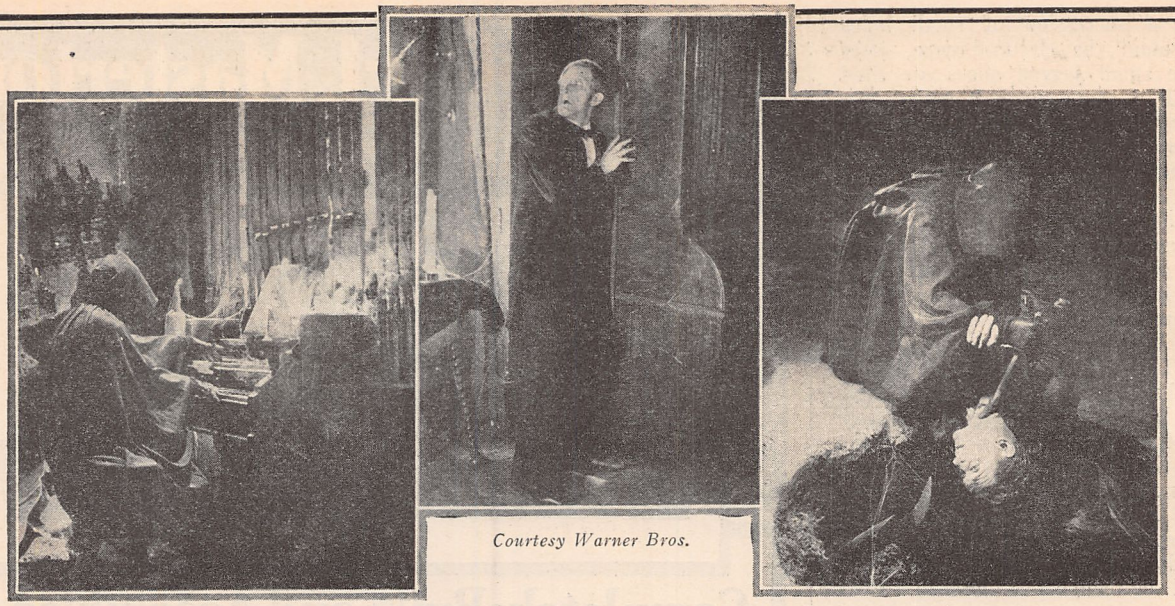

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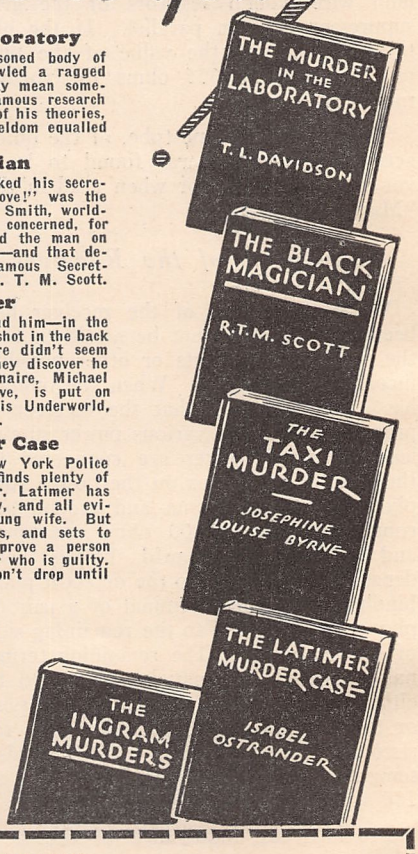


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The adjusting screws of the variodensers are now tightened (don't force the screw as this might break the device), after which each is loosened 1½ turns. The power switch, mounted on the volume control (R7) shaft is turned on. Each tube is inspected for heater action, a dim light should be noted. After a few seconds the r. f. drum is slowly rotated, meanwhile rotating the oscillator drum over a scale section of approximately 30 degrees. If the oscillator is functioning, all tubes perfect, a broadcast signal should be heard in the phones although the signal may be very weak.

If no signal is heard the oscillator tube should be observed for oscillation. This may be accomplished by inserting a pair of phones in the "B" plus return. Touching the grid and plate terminals of the socket with a wet finger tip, a plop should be heard on the placement and the removal of the finger will indicate oscillation, providing the action is observed on both the grid and plate. In rare cases it may be necessary to increase the number of turns in the plate coil of the oscillator coupler. The number of turns in this winding must always be kept as low as possible. In some cases the plate winding may be reversed and must be connected properly. If the coupler is contructed according to the detail drawing and to the description, there is no possible chance of the misconnection.

When the oscillator is functioning properly and a signal is heard in the phones connected in the plate circuit of the detector, the variodensers with the exception of C5 and C29, are adjusted for loudest signal. The coupling between the band filter transformer primaries and secondaries should be approximately 1¾ inches. If these coils have been properly matched no difficulty will be experienced in obtaining a definite resonant peak by the adjustment of the variodensers. By further adjusting the coupling between the coils the frequency of hand-pass may be obtained very effectively. It may be found necessary at this time to re-adjust (C5). If this condenser is re-adjusted it will become necessary to readjust the other variodensers again as described.

The variodenser (C29) shunting the oscillator variable condenser is now adjusted to bring the scale reading of both drums nearly the same. The builder is cautioned against rapid rotation of the tuning drums as it is very easy to pass over even the most powerful broadcast signal. When the receiver is in perfect working order the author hopes that the builder will obtain the same pleasure and develop the same enthusiasm, after pulling in station after station, DX and locals of various power, from one end of the tuning scale of the drums to the other. After proficiency of tuning is developed the builder will be able to pull in greater or Super-DX with ease. The author would be very glad to hear from "Magister" builders and owners. He will also endeavor to answer any questions concerning this receiver collectively through the medium of RADIO NEWS pages from time to time.


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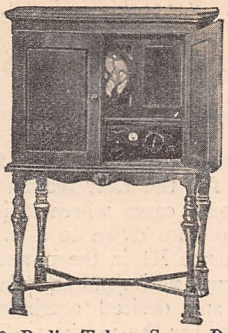

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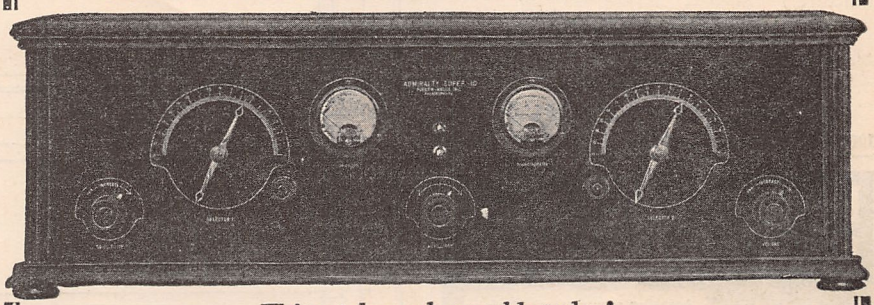

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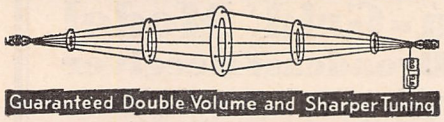

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Dealers in Bankrupt Radio Stocks

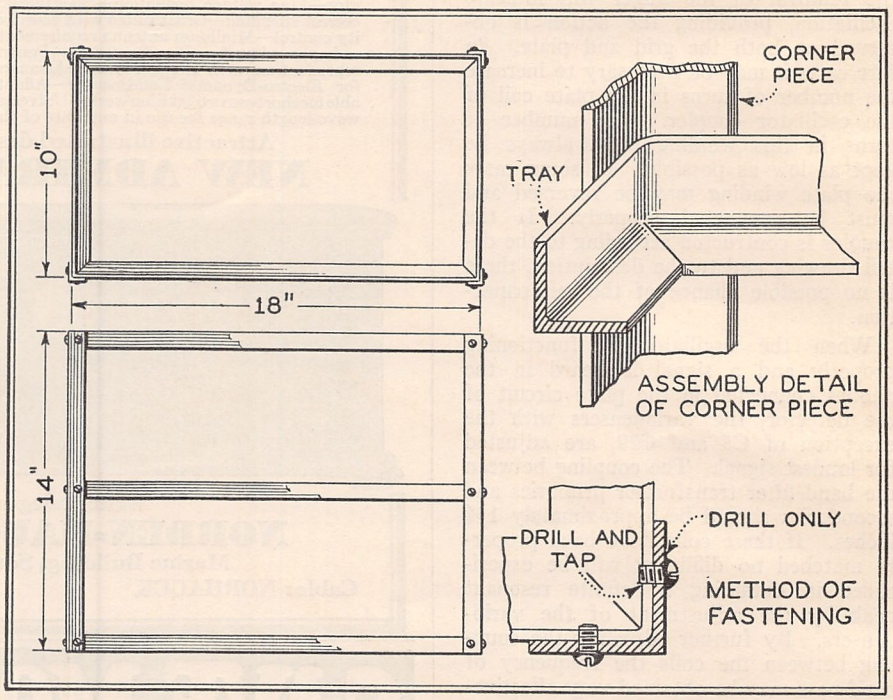

# The Compact Flexible Speech Amplifier

(*Continued from page 328*)

ceiver through the switch JSN2 on the amplifier panel. If the filaments in the receiver are to be a. c. operated, a double pole, double throw snap switch should replace this switch, one side to be used for the bleeder circuit and the other for the 110 V. a. c. supply to the receiver filament transformer. The use of a storage battery for the r. f. filament is desirable in some cases where it is necessary to keep hum down to a minimum.

The resistence R1 in the power supply unit is equipped with semi-adjustable taps to provide any desired combination of plate voltages for the receiver. The output transformer incorporated in the amplifier is designed to feed into a dynamic speaker. A different type should be employed for use with magnetic speakers. Where two dynamic speakers are to be employed, it will be found best to connect them in series. In the case of magnetic speakers, if several are to be employed, they should be connected in series-parallel groups so that their total impedance will be equal to the impedance of a single speaker, or as nearly so as is possible.

There is no necessity for a verbal description of the construction of this amplifier. The very complete illustrations will provide all of the information necessary to an experienced constructor. However, some suggestions regarding the proper adjustment of the unit will be helpful.




A sketch showing the framework of the amplifier

## *Adjustment and Operation*

Assuming that the construction and wiring have been completed, it is necessary that the taps on the output resistance network, R1, be adjusted before the assembly of the case has been completed. To make these adjustments the receiver, phonograph and the speaker should be connected up so that a complete operating test can be made. All tubes should be put in place in the receiver, and a 112A, a 350, and a 381 should be placed in their respective sockets in the amplifier unit. Then after making sure that the main control switch SW1 is turned to the "off" position, the amplifier may be plugged into the a. c. line. Next, the knobs controlling the C bias resistors R2 and R3 should be adjusted to their center positions and the milliammeter plug inserted in J2 ready to provide a reading of the plate current for the 350 tube. The receiver filaments may now be turned on in readiness for operation, and finally the main control switch SW1 may be turned on.

Immediately upon turning the amplifier on, the knob of the grid bias resistance for the 350 tube should be adjusted to show a plate current reading of 55 milliamperes. This immediate adjustment is made to avoid the possibility of damaging the tube by applying excessive current due to improper grid bias. The taps of resistor R1 are adjusted by first loosening the set screws and sliding the metal bands along the resistor unit. When in proper position they may be permanently fastened in place again. In order to make these adjustments a high resistance voltmeter is needed. This is first connected across the 135 volt tap and this tap adjusted to provide a 135 volt reading on the voltmeter. Then the other taps are similarly adjusted, one after the other, until the plate voltages

required by the receiver and first stage audio tubes have been exactly adjusted. Next, connect the voltmeter across the resistor R2 and adjust the knob of this resistor until the meter shows a drop of nine volts, which is the bias required for the 112 tube with a plate voltage of 135. At this point it is advisable to again check the 135 volt tap to make sure that it has not been affected by the adjustment of the C bias.

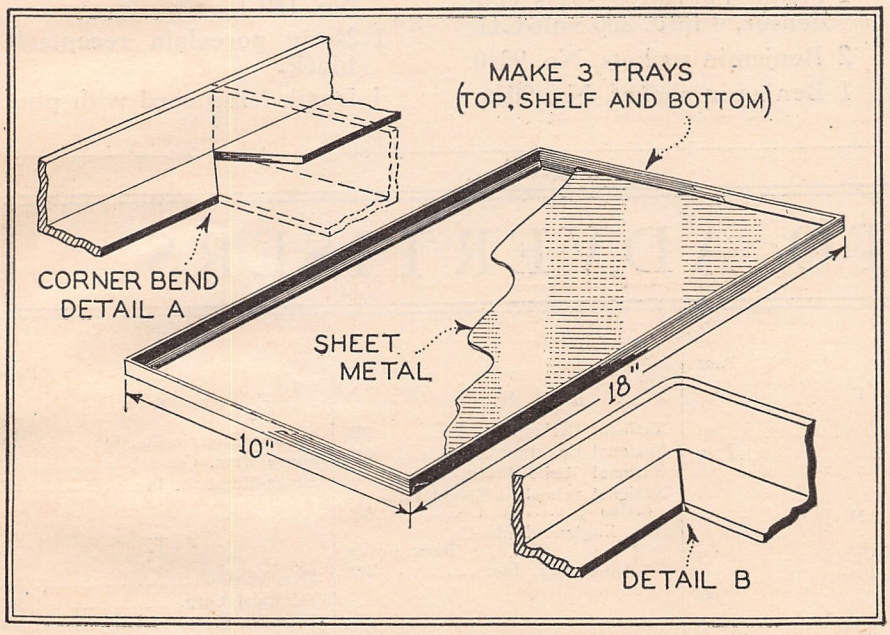
The C bias for the power tube is measured by connecting the voltmeter directly across the portion of resistor R3 that is actually in the circuit. With the knob of this resistor adjusted to show a plate current of 55 milliamperes, the voltage reading across the biasing resistor should be very close to 84 volts. If at this current drain the bias voltage reading is 90 volts or higher, it is an indication that the 350 tube plate voltage (measured from the 350 tube filament center tap to the plate of this tube) is higher than the required 450 volts. Such excessive voltage may be the result of employing a receiver with very low plate current drain and may be corrected in one or two ways.

The first method is to connect a variable heavy duty resistance in series with the high voltage side of the rectifier output between the rectifier and the first filter condenser, C3. This arrangement has the advantage that the excess voltage will not be applied to the filter condensers. However, a more convenient and quite satisfactory method of reducing the high voltage is to take the power tube plate supply off next to the highest tap of the resistor R1, moving this tap to provide the correct voltage.

The bleeder resistance, R5, is next adjusted. In the schematic diagram the high potential end of this resistor is shown connected to the high voltage output of the power supply. It may be found better to connect it to one of the lower voltage taps. The best one will depend on the plate current drawn by the receiver, and it should be the tap through which most of the receiver plate current is drawn. This will usually be the 90 volt tap, although in the case of a superheterodyne receiver it may be the 45 or 67 volt taps. If this resistance is left connected as shown in the schematic diagram, it will have a tendency to change the voltage on the plate of the first amplifier tube when the receiver is turned off but the amplifier left in operation. Inasmuch as this resistance is provided to compensate for receiver current drain, It is only logical that it be connected to the tap providing the greatest current to the receiver. The simplest method for adjusting this resistance to absorb the exact amount of current drawn by the receiver is to plug the milliammeter into J1 while the receiver is in operation. Note the milliammeter reading. Then turn off the receiver by means of the switch JSW2 and adjust the bleeder resistance until the milliammeter again shows the same current drain.

It may be desirable to arrange the complete installation in such a way that the main control switch SW1 of the amplifier will control not only the amplifier, but also the field supply to dynamic speakers and perhaps an a. c. supply to the receiver unit. If so, it is only necessary to install standard outlet receptacles on the exterior of the amplifier case and supply these through the main switch. If an a. c. receiver is employed and a phonograph is also used, it will still be necessary to incorporate a switch (a. c. type) as indicated at JSW-2, in order that the receiver may be turned off when the phonograph is in use, thus avoiding undue wear on the receiver tubes.

This amplifier, when set up and put into use, should provide extremely satisfactory results. The tone quality will be exceptionally good and everything about the unit is calculated to provide a happy combination of truthful reproduction, freedom from breakdown, and flexibility of service. Simplicity of operation is another outstanding feature that will be ap-




**A detailed drawing showing how the corners and frame for the trays are constructed**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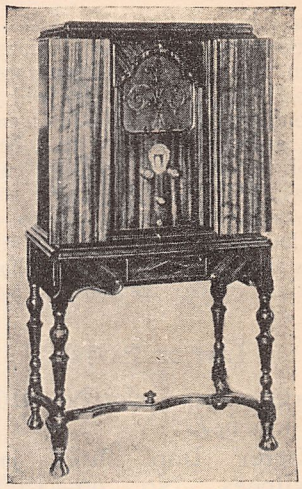
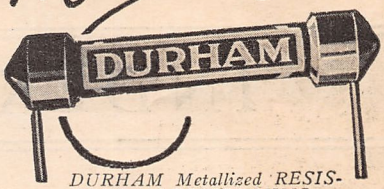


FREED NR-95 Radio

*Metallized*

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preciated by anyone for whom such an amplifier is installed. For readers who may desire to build higher power amplifiers, the foregoing descriptive matter will be most helpful because many of the ideas featured in the present amplifier may be successfully incorporated in others.

* * * * *

In the subsequent articles of this series descriptions of typical installations will be given, together with illustrations and diagrams. These descriptions will be of exceptional value to installation men, and to men entering this new field, because many of the technical problems encountered will be discussed—such, for instance, as the proper connections where several loud speakers are to operate from a single amplifier, types and methods of installation wiring, methods of volume control, etc.

### LIST OF PARTS

5 Yaxley Pup jacks, No. 416—3, 4, 5, 6, 7.
2 Carter Imp short jack switches, No. 66—JSW1, JSW2.
1 Electrad Super Tonatrol (constant) type U—R4.
1 Electrad Truvolt, T10—R2.
1 Electrad Truvolt, T20—R3.
1 Electrad Truvolt, T500—R5.
2 Carter Short jacks closed circuit, No. 2A—J1, J2.
1 Carter "Tu Way" telephone jacks.
1 Weston Milliammeter, 0-100 MA, type 301—M.
1 Amertran DeLuxe first stage audio transformer—T1.
1 Amertran DeLuxe second stage audio transformer—T2.
1 Amertram output transformer, type 200—T3.
1 Amertran Equalizer transformer, No. 389-T4.
1 Afertran output transformer, type 200-T3.
8 Acme parvolt by-pass condensers, 1 mfd. 200 volt—C1, C2, C6, C7, C8, C9, C10, C12.
1 Acme Parvolt by-pass condenser, 4 mfd. 200 volt-C11.
2 Benjamin sockets, No. 9040.
1 Benjamin socket, No. 9036.
1 Roll Acme flexible twisted filament wire.
2 Rolls Acme 16-30 flexible Celastite 6-32" nuts and screws.
1 227 type tube-V1.
1 250 type tube-V2.
1 281 type tube-V3.
19 ft. Angle Iron, ½"x½".
2 Sheets Iron, 3-32"x18"x10".
Wire netting, 18" wide x 7 ft, ¼" mesh
1 Panel Bakelite, 7"x18".
1 Amertran power transformer, type P. F. 281-T5.
1 Electrad voltage divider, type 250 ("C Bias" resistor not used) -R1.
3 Acme Parvolt filter condensers, 2 mfd. 1000 volt - C3, C4, C5.
2 Amertran chokes, type 709 L1, L2.
1 4 Point line switch-2.
1 Carter Imp power switch, No. 110-1.
1 2-way porcelain receptacle block.
1 length lamp cord with plug.

# INDEX TO ADVERTISERS


PAGE

A

Advance Electric Co. ..... 366
Aerovox Wireless Corp. ..... 360
Allied Radio Corporation..... 303
American Sales Co. ..... 383
American Technical Society.... 354
American Transformer Co. .... 369
Amperite Corporation ..... 368
Anita Institute ..... 372

B

Barawik Company, The.....373-384

C

Central Radio Labs. ..... 364
Chicago Radio Apparatus Co... 368
Chicago Salvage Stock Store.. 355
Clarostat Mfg. Co., Inc..... 370
Colonial Radio Corporation..300-301
Cornish Wire Co. ..... 366
Coyne Electrical School..... 291

D

Davis Publishing Co., The Bryan ..... 361
De Forest Radio Co. ..... 299

E

Electrad, Inc. ..... 359
Excello Products Corp. ..... 362

PAGE

F

Federal M. O. Corp. ..... 360
Ferranti, Inc. ..... 368

H

Hammarlund Mfg. Co. ..... 374
Hammarlund-Roberts, Inc..... 373
Hart Tire Co. ..... 354
High Frequency Labs. ..... 375
Hoodwin Co., Chas. ..... 378

I

International Resistance Co.... 379

J

J-M-P Mfg. Co., Inc. ..... 360
Jiffy-Tite Mfg. Co..... 368

L

Lyons Mfg. Co. ..... 370

M

Mason, Fenwick & Lawrence.. 368
Metal Cast Products Co. ..... 374
Midland Tire & Rubber Co.... 370
Midwest Radio Corporation Inside Back Cover

PAGE

N

National Carbon Co., Inc..... 295
National Co., Inc. ..... 296
National Radio Institute....293-367
National School of Visual Education ..... 378
New England Mills Co. Back Cover
Norden-Hauck, Inc. ..... 377

O

Omnigraph Mfg. Co. ..... 383

P

Payne, R. S. ..... 368
Piccadilly Hotel ..... 368
Pilot Radio & Tube Corp..... 357
Plapao Labs., Inc. ..... 364
Pohl Bros. ..... 364
Process Corporation, The..... 374

R

Racon Electric Co., Inc. ..... 372
Radiall Co. ..... 368
Radio Doctors, Inc. ..... 375
Radio Institute of America.... 353
Radio Manufacturers' Show Ass'n ..... 365
Radio Training Association of America ..... 289
Radio World ..... 363
Royal Eastern Electrical Supply Co. ..... 372

PAGE

S

Samson Electric Co., Inc. ..... 294
Shure Bros. Co. ..... 354
Silver-Marshall, Inc. ..... 297

T

Teleplex Co. ..... 378
Televocal Corp. ..... 383
Thomas, C. M. ..... 368
Thorola Radio Products..... 378
Townsend Labs. ..... 362
Triad Mfg. Co., Inc. Inside Front Cover

V

Van Nostrand Co., D. ..... 371

W

Western Radio Mfg. Co.....362-368
West Side Y. M. C. A. Radio Institute ..... 370
Wholesale Radio Service Co.... 377
Wiley & Sons, Inc., John..... 381
Wireless Egert Engineering, Inc. ..... 370
Workrite Radio Corp., The..... 365

Y

Yaxley Mfg. Co. ..... 373


While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.

## Building A 245 Power Amplifier

(*Continued from page 315*)

off the current to the receiver entirely.

Connections of one unit to another within the console cabinet should be made by means of cabled leads, bunched together and bound with cord. Here, it is advisable to employ a color wiring so that in the case of error in connection, it will be easy to trace the wiring from one point to another.

It will be noted in Fig. 2 that an intermediate terminal board has been provided between the radio tuner unit and the audio amplifier-power supply so that connection of the plate voltage leads from the power supply to the tuner unit may be made first to the intermediate terminal board. This terminal board is employed so that if it is desired to change either the tuner or amplifier, this may be done without disturbing the connections to the other. A similar terminal board may be employed, if it is desired, to connect the leads from the jack switch, SJ, to the audio amplifier. Thus, any one of the units may be removed at will, without disturbing the remaining connections to the other unit.

It is well to remember that the 110 volt supply cord to the power transformer and to the filament transformer and phonograph motor should be placed in the cabinet so as not to be near the tuner unit. Otherwise a disagreeable hum will be picked up from the line and amplified accordingly, producing the most disagreeable hum in the loud speaker.

The design of the audio amplifier power supply device and the layout of the installation described here is offered to those desiring a suitable power supply unit housed, together with the tuner unit, in an acceptable type of console cabinet. Where the console to be used differs materially from the one illustrated, it will, of course, be up to the ingenuity of the constructor to arrange the location of the various units, so that not only will desirable, satisfactory results be obtained, but also a pleasing workmanlike appearance of the entire installation result.

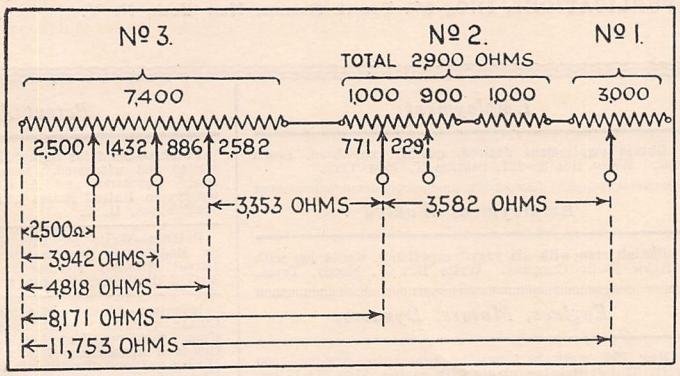



**Fig. 6. The Carter Resistor Kit No. 2314, consisting of three units, has its taps rearranged according to the circuit sketch shown at the right**

*Audio Amplifier—Power Supply Parts List*

AUDIO AMPLIFIER:

One Thordarson audio transformer, type R400, T1.

One Thordarson input push-pull transformer, type 2922, T2.

One Thordarson output push-pull transformer, type 2903, T3.

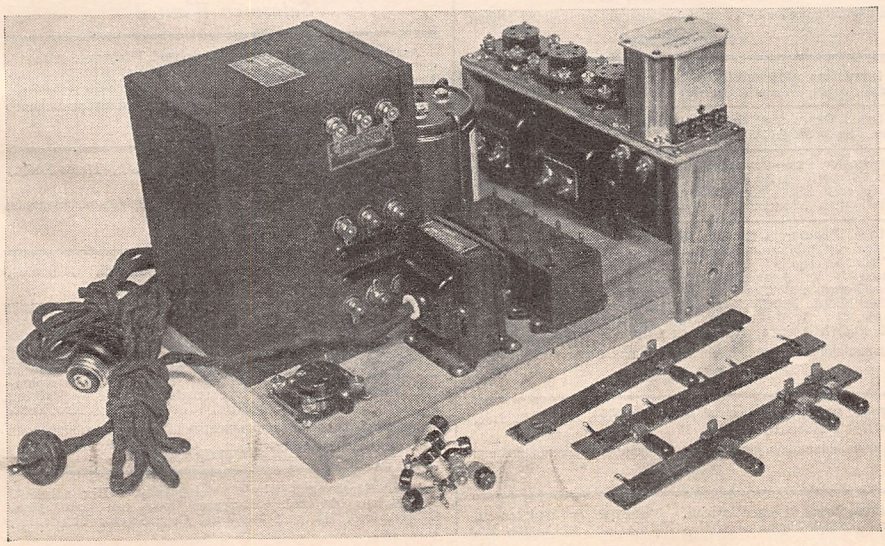
One Amertran equalizer transformer, No. 389, T4.

One Benjamin five-prong a. c. socket, No. 9036, V1.

Two Benjamin red top sockets, No. 9040, V2, V3.

(*Continued on page 383*)

**A partly assembled view of the amplifier power supply device**



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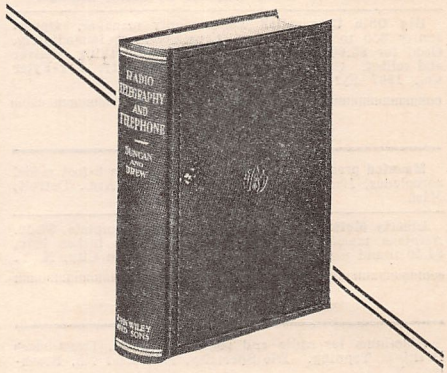

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(*Continued from page 381*)

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One Carter wire-wound grid resistor, type P-5-800, 800 ohms, R7.
One Carter center-tapped resistor, type CE-6, 6 ohms.
One Aerovox by-pass condenser, C1, 1 mfd.
One shelf with end pieces (as described).
One box Corwico Stranded Braidite.

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One Carter resistor kit, No. 2314, R1 to R5.
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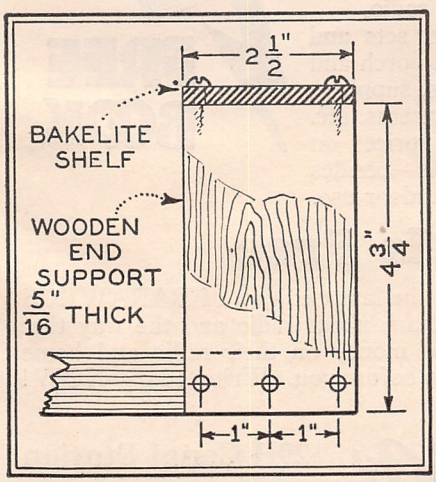


Fig. 5. Make two end pieces for supporting the shelf as shown here


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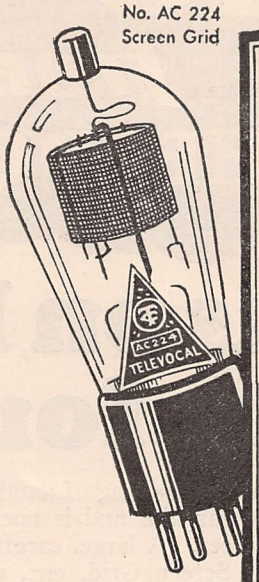


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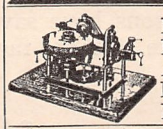

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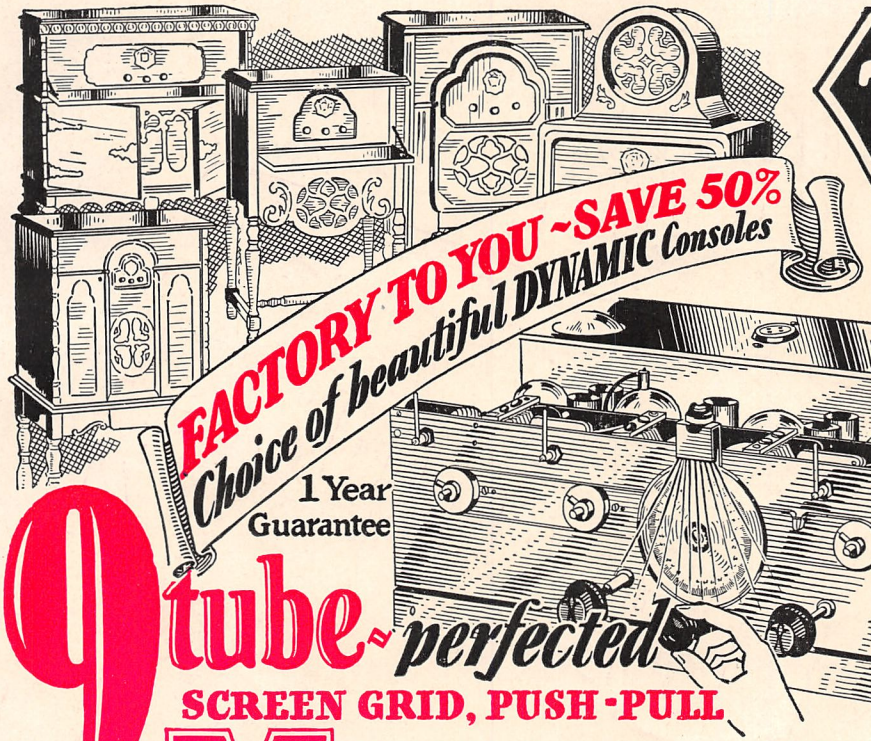

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ESTABLISHED 1912

## Why Our Prices are Low

We are one of the largest outlets by mail to the trade. Our connections with many of America's leading factories enables us to buy on our own terms. Our cash resources makes it possible to command the very lowest prices from manufacturers—in most cases merely a small margin above actual manufacturing costs—and frequently at lower than cost. This in turn is reflected in the net **wholesale prices** we show in our catalog. We give our customers the benefit of our vast purchasing power.

### All Radio Dealers Save Money

by trading with New England Mills. This saving applies to complete radio sets of every description, dynamic and magnetic speakers, A. C. and all other types of tubes, eliminators, batteries, radio cabinets—in fact, everything required by dealers for resale or servicing. Every dealer knows that by buying right he is in position to sell at **prices that meet all kinds of competition,** thereby increasing his profits and good-will.

### Set Builders and Repair Men!

A tremendous amount of business will be done this season in rebuilding sets which users want to keep, and by modernizing old models. Our catalog contains everything required for this work. Besides, we have a supply of the **latest models** of **nationally renowned kits**—either knocked down or completely assembled chassis ready to install in table or console cabinets, all at **wholesale prices** that permit of excellent profits to you.

### A. C. Electric Radios

Our new catalog contains a large selection of the finest A. C. Electric, 6, 7, 8 and 9 tube chassis and complete sets obtainable at the amazingly low prices we quote. Every modern radio improvement is embodied in these **marvelous electric radios.** All are sold by us with the **guarantee of satisfaction** backed by this 17 year old institution.

### BATTERY SETS FOR UNWIRED HOMES

The vast number of rural communities with homes that are not wired for electric radios offer a tremendous market for battery sets, repairs and replacements. We have not overlooked this important field, as evidenced by the **large stock of batteries, eliminators, speakers, tubes, transformers, coils,** and all kinds of accessories needed for battery sets. These supplies include some of the **best known nationally advertised goods,** such as **Cunningham, Sonatron,** and **Arcturus tubes, Burgess batteries, Jewel instruments, Belden Products, Utah, Temple, Farrand** and other popular **dynamic** and **magnetic speakers.**

### Send for Free Book *Now!*

Radio dealers, agents, set builders, service men, etc., cannot afford to be without the New England Mills catalog. It contains everything you need for a more profitable radio business. We maintain a complete radio service department, supervised by expert radio engineers who will help you with all your radio problems. All goods catalogued are stocked for immediate shipment. Write for this book today. It's FREE! Send request on your business stationery.

**17 Years in Business**

**NEW ENGLAND MILLS COMPANY**
**851 Washington Blvd., Dept. 11, Chicago, Ill.**